Effect of propofol on immune function, stress response and hemodynamics in patients undergoing colorectal cancer surgery

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ABSTRACT

Objective: To investigate the effects of propofol on immune function, stress response and hemodynamics in patients undergoing colorectal cancer surgery. Methods: 90 patients who were undergoing laparoscopic radical resection of colorectal cancer were randomly divided into propofol group (n=45) and sevoflurane group (n=45). The propofol group was anesthetized with propofol and the control group was given the same dose of sevoflurane. Changes in HR, SBP and DBP were observed before anesthesia, 1 h after induction, and at the end of surgery. The levels of CD19+, NK cells, MDA, SOD, insulin and cortisol were measured before anesthesia, at the end of operation and 24 h after operation. Results: Compared with before anesthesia, the levels of HR, SBP and DBP decreased at 1 h after induction (all \(P<0.05\)). At the end of the surgery, HR, SBP, and DBP returned to pre-anesthesia levels in both groups. The levels of HR, SBP and DBP in the propofol group were (74.56±7.55) times/min, (108.34±10.71) mmHg and (76.35±7.65) mmHg were higher than those in the sevoflurane group (all \(P<0.05\)). Compared with before anesthesia, CD19+ and NK cell ratio decreased at the end of surgery and 24 h after surgery, while MDA level increased at the end of surgery and 24 h after surgery (\(P<0.05\)). At the end of the propofol group, the proportion of CD19+ and NK cells in the propofol group were (7.23±0.83)% and (15.17±1.21)%, which were higher than those in the sevoflurane group (all \(P<0.05\)).

1. Introduction

Colorectal cancer is a common digestive system tumor, and the current main treatment is surgery[1]. Because of the low physical quality of patients with colorectal cancer, they are less tolerant to surgery[2]. Good anesthesia effect can not only improve the safety, but also help patients recover, also can reduce the occurrence of postoperative complications[3]. Both propofol and sevoflurane are commonly used in general anesthesia in clinic. Some studies have suggested that sevoflurane has little effect on hemodynamics. Some scholars believed that propofol has little effect on immune function
of patients. There are still divergence in their effect comparison[4,5], so this study compared the effects of two drugs on immune function, stress response and hemodynamics in patients with colorectal cancer, as reported below.

2. Materials and methods

2.1 Clinical data

From July 2015 to November 2016, the clinical data of 90 patients undergoing laparoscopic radical resection of colorectal cancer admitted to our hospital were collected, inclusion criteria: (1) All patients were eligible for histopathological diagnosis of colorectal cancer[6]; (2) age between 25 and 75 years old; (3) American Society of Anesthesiologists (ASA) scores I to II; (4) no radiotherapy or chemotherapy before surgery. According to the random number table method, it was divided into propofol group and sevoflurane group, 45 cases in each group. There were 23 males and 22 females in the propofol group, aged 25-74 years old, 30 patients with ASA I, 15 patients with ASA II, in the sevoflurane group, 21 males and 24 females, aged 26-75 years old, 29 cases of ASA grade I and 16 cases of ASA grade II. There were no significant differences in gender, age, and ASA classification between the two groups ($P>0.05$), which were comparable. Exclusion criteria: (1) preoperative chemoradiotherapy; (2) associated with rheumatoid disease or basic diseases such as diabetes and hypertension; (3) allergic to propofol or sevoflurane; (4) took anticoagulant drug before surgery. This study was approved by the Medical Ethics Committee of the hospital. All cases included in the study were volunteered and signed informed consent.

2.2 Treatment method

All patients need to be fasting for solids and liquids before surgery. After entering the operating room, immediately connect the monitor to monitor patient heart rate (Heart rate, HR), diastolic blood pressure (Diastolic blood pressure, DBP) and systolic blood pressure (Systolic blood pressure, SBP), and preoperative induction of anesthesia, intravenous injection 0.05 mg/kg midazolam (Jiangsu Enhua Pharmaceutical Co., Ltd., Approval number H20143222), 0.25 mg/kg etomidate (Jiangsu Enhua Pharmaceutical Co., Ltd., Approval number H32022999), 1 ug/kg of Remifentanil Hydrochloride Injection (Yichang Renfu Pharmaceutical Co., Ltd., Approval number H20030197), 0.15 mg/kg of cis-a-tracurium (Zhejiang Xianju Pharmaceutical Co., Ltd., Approval number H20090202). On the basis of the above, the propofol group was intravenously infused with 1-2 mg/kg propofol (Sichuan Guorui Pharmaceutical Co., Ltd., Approval number H20030115), and 0.6 mg/kg rocuronium was used after the patient was asleep. (N.V.ORGANON, Approval number: JX20000288) Intravenous infusion, and connected to the ventilator with an endotracheal tube. Sevoflurane based on the above at 6 L/min oxygen flow rate and 8% sevoflurane, until the patient using 1 L/min oxygen flow, 5% sevoflurane after deep sleeping, then using 0.6 mg/kg rocuronium intravenous infusion, then connect the ventilator with an endotracheal tube.

2.3 Observation indicators

(1) Hemodynamic index test: HR, SBP and DBP were recorded before the anesthesia, 1 h after induction and at the end of the operation; (2) Detection of immune function indicators: before anesthesia, at the end of surgery and after 24 h of surgery, 2 mL of venous peripheral blood was collected from patients (fasting was required), and the proportion of CD19+ and NK cells was detected by flow cytometry. (3) Detection of stress indicators: Collect 2 mL of venous peripheral blood (fading is required) before anesthesia, at the end of surgery, and 24 h after surgery, centrifuge to take serum for use. The levels of malondialdehyde (MDA), superoxide dismutase (SOD), insulin (RI) and cortisol (COR) were measured by ELISA. The above ELISA kits were all provided by Shanghai Hengfei Bio. Technology Co., Ltd.

2.4 Statistical methods

Statistical analysis was performed using the SPSS19.0 statistical software. The HR, SBP and DBP levels were verified to be in a normal distribution, expressed as mean ± standard deviation ($\bar{x} \pm s$), and the levels of each indicator were compared between groups. An independent t test was used, $P<0.05$ indicated that the difference was statistically significant.

3. Results

3.1 Comparison of HR, SBP and DBP between the two groups

As shown in Table 1, compared with before anesthesia, the HR, SBP and DBP levels were decreased at 1 h after induction (all $P<0.05$). At the end of the operation, HR, SBP and DBP returned to pre-anesthesia levels in both groups. The levels of HR, SBP and DBP in the propofol group were $(74.56 \pm 7.55)$ times/min, $(108.34 \pm 10.71)$ mmHg and $(76.35 \pm 7.65)$ mmHg were higher than those in the sevoflurane group ($P<0.05$).

<table>
<thead>
<tr>
<th>Table 1.</th>
<th>Comparison of HR, SBP and DBP between the two groups.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>Cases</td>
</tr>
<tr>
<td>Propofol group</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Sevoflurane group</td>
<td>45</td>
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<td></td>
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<td></td>
<td></td>
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</tbody>
</table>

* $P<0.05$ compared with before anesthesia; compared with the sevoflurane group at the same time point, $\# P<0.05$. 
3.2 Comparison of CD19+ and NK cells in the two groups

As seen in Table 2, compared with before anesthesia, the proportion of CD19+ and NK cells decreased at the end of surgery and 24 h after surgery, and the proportion of CD19+ and NK cells in the propofol group was (7.23±0.83)% and (15.17±1.21)% respectively, which were higher than the sevoflurane group (both $P<0.05$). At 24 h after surgery, the proportions of CD19+ and NK cells in the propofol group were (9.68±0.96)% and (19.58±1.86)% respectively, which were higher than those in the sevoflurane group (both $P<0.05$).

Table 2.

Comparison of CD19+ and NK cells in both groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Cases</th>
<th>Time</th>
<th>CD19+(%)</th>
<th>NK(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol group</td>
<td>45</td>
<td>Before anesthesia</td>
<td>13.92±1.33</td>
<td>27.91±2.93</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 h after induction</td>
<td>7.23±0.83</td>
<td>15.17±1.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At the end of the operation</td>
<td>9.68±0.96</td>
<td>19.58±1.86</td>
</tr>
<tr>
<td>Sevoflurane group</td>
<td>45</td>
<td>Before anesthesia</td>
<td>14.2±1.61</td>
<td>26.98±2.51</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 h after induction</td>
<td>6.44±0.54</td>
<td>12.85±1.41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At the end of the operation</td>
<td>8.78±0.73</td>
<td>15.3±1.50</td>
</tr>
</tbody>
</table>

$P<0.05$ compared with before anesthesia; compared with the sevoflurane group at the same time point, $P<0.05$.

3.3 Comparison of MDA and SOD levels between the two groups

As seen in Table 3, compared with before anesthesia, MDA levels increased and SOD levels decreased at the end of surgery (both $P<0.05$). 24 h after surgery, the level was returned as before anesthesia, at the end of the propofol group, the MDA level was (6.15±0.62) mmol/L lower than that of the sevoflurane group, and the SOD level was (98.75±9.78) nU/mL higher than that of the sevoflurane group (both $P<0.05$).

Table 3.

Comparison of MDA and SOD levels between the two groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>Cases</th>
<th>Time</th>
<th>MDA (mmol/L)</th>
<th>SOD (nU/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol group</td>
<td>45</td>
<td>Before anesthesia</td>
<td>4.75±0.48</td>
<td>108.85±10.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 h after induction</td>
<td>6.15±0.62</td>
<td>98.75±9.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At the end of the operation</td>
<td>4.89±0.149</td>
<td>107.3±10.74</td>
</tr>
<tr>
<td>Sevoflurane group</td>
<td>45</td>
<td>Before anesthesia</td>
<td>4.78±0.48</td>
<td>106.8±10.76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 h after induction</td>
<td>7.06±0.71</td>
<td>94.68±9.47</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At the end of the operation</td>
<td>4.96±0.50</td>
<td>105.7±10.67</td>
</tr>
</tbody>
</table>

$P<0.05$ compared with before anesthesia; compared with the sevoflurane group at the same time point, $P<0.05$.

3.4 Comparison of insulin and cortisol in the two groups

As shown in Table 4, compared with before anesthesia, the levels of insulin (RI) and cortisol (COR) were significantly increased at the end of surgery and 24 h after surgery (both $P<0.05$). In the propofol group, the insulin was (22.69±2.28) mIU/mL higher than the sevoflurane group, and the propofol group was (171.59±17.12) ng/mL lower than the sevoflurane group (all $P<0.05$).

4. Discussion

It has been reported in the literature that the incidence of colorectal cancer ranks third in cancer, and the main cause of death is metastasis[7]. Early colon cancer patients can be treated by laparoscopic radical surgery for colorectal cancer. Numerous studies have shown that anesthesia has a certain impact on hemodynamics, immune function and stress response in patients with colorectal cancer[8-10]. Some general anesthetics may inhibit the patient’s acquired immune function or innate immune function. Sevoflurane has the advantages of rapid induction and short recovery time and has less impact on the patient’s respiratory and cardiovascular system[11]. Propofol is more fat soluble, has the advantages of short onset time, quick recovery and high safety, and has less effect on respiratory system and liver and kidney function[12]. The aim of this study was to investigate the effects of two drugs on immune function, hemodynamics, and stress response, providing basic information for clinical treatment.

This study found that compared with before anesthesia, HR, SBP and DBP levels decreased at 1 h after induction, and HR, SBP and DBP returned to pre-anesthesia levels at the end of surgery. The levels of HR, SBP and DBP were higher in the propofol group than in the sevoflurane group at 1 h after induction. It indicated that propofol intravenous anesthesia has little effect on hemodynamics and with high safety, which is consistent with previous studies[13]. Studies have found that propofol can improve the level of oxidative stress in patients, while improving cognitive function in patients[14]. This study found that compared with pre-anesthesia, MDA levels increased and SOD levels decreased at the end of surgery. The level before anesthesia was returned at 24 h after surgery. At the end of the operation in propofol group, the MDA level was lower than that of sevoflurane, and the SOD level was higher than that of the sevoflurane group. It is speculated that the possible causes are: propofol is highly lipophilic and regulates neurological function and hormone levels after induction of anesthesia, which can inhibit the...
high stress state caused by the disease itself to some extent.

NK cell-mediated innate immunity plays an important role in tumors, which can directly kill cancer cells[15]. B lymphocytes can differentiate into plasma cells and interfere with tumor growth by secreting various immunoglobulins[16,17]. Some scholars believed that propofol can inhibit the apoptosis of B lymphocytes and NK cells in cancer patients or critically ill patients[18]. The study found that the ratio of CD19+ and NK cells at the end of surgery and 24 h after surgery was lower than that before anesthesia. The proportion of D19+ and NK cells in the propofol group was higher than that in the sevoflurane group at the end of surgery and 24 h after surgery. It was indicated after anesthesia the humoral immune function of both groups was inhibited to a certain extent, and propofol had little effect on immune function. The possible causes are: (1) laparoscopic colorectal cancer surgery itself causes certain damage, immune function will be inhibited to a certain extent; (2) propofol stimulates the patient’s body less, reduces stress response, and therefore the effect on immune function is small.

It has been reported in the literature that the stress response can be used as a result of surgical stress response[19]. Insulin promotes the synthesis and storage of glycogen and reduces glucose levels[20]. Cortisol is a glucocorticoid used to assess the severity of stress in the body[21]. Foreign studies have pointed out that the application of propofol to surgical stress can effectively improve the levels of renin and adrenocorticotropic hormone, thereby relieving stress response[22]. However, this study found that compared with pre-anesthesia, insulin and cortisol levels increased at the end of surgery and 24 h after surgery. At the end of surgery, insulin in the propofol group was lower than that in the sevoflurane group, cortisol was lower than the sevoflurane group. It is suggested that under the stimulation of surgery and anesthesia, patients will appear obvious stress response, and propofol can effectively reduce the level of stress response patients. This may be related to that propofol can effectively inhibit thalamic-pituitary-adrenal axis activity and stress response patients. This may be related to that propofol can effectively inhibit thalamic-pituitary-adrenal axis activity and stress response, and propofol can effectively reduce the level of stress response.

In summary, intravenous anesthesia with propofol before surgery for colorectal cancer radical surgery can effectively alleviate oxidative stress and inflammatory stress response and has little effect on hemodynamic parameters and stress response, which is beneficial to recovery of immune function in patients.

References


