Relationship of incision infection after colorectal cancer surgery with the body’s nutritional status, immune function and inflammatory factors

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ARTICLE INFO

Objective: To study the relationship of incision infection after colorectal cancer surgery with the body’s nutritional status, immune function and inflammatory factors. Methods: 146 patients who received radical operation for colorectal cancer in our hospital between June 2013 and December 2015 were selected and divided into infection group and non-infection group respectively according to the postoperative incision infection. 1 d before operation, the same day after operation and 3 d after operation, serum was collected respectively to detect nutritional indexes and inflammatory factors, and peripheral blood was collected to determine the levels of immune cells and erythrocyte immune molecules. Results: The same day after operation, serum Hb, TP, Alb, PA and Tf levels of both groups were not significantly different from those 1 d before operation, the peripheral blood CD3+CD4+, CD3+CD8+, CD16+CD56+, CD19+, CR1, CR3, CD58 and CD59 levels were significantly lower (P<0.05) than those 1 d before operation, and 1 d before operation as well as the same day after operation, serum hemoglobin (Hb), total protein (TP), albumin (Alb), prealbumin (PA) and transferrin (Tf) levels as well as peripheral blood CD3+CD4+, CD3+CD8+, CD16+CD56+, CD19+, CR1, CR3, CD58 and CD59 levels of infection group were significantly lower (P<0.05) than those of non-infection group; 3 d after operation, serum TNF-α, PCT, IL-1β, MCP-1 and hs-CRP levels of infection group were significantly higher (P<0.05) than those of non-infection group and negatively correlated with serum Hb, TP, Alb, PA and Tf levels as well as peripheral blood CD3+CD4+, CD3+CD8+, CD16+CD56+, CD19+, CR1, CR3, CD58 and CD59 levels. Conclusion: Perioperative poor nutritional status and immunosuppression can increase the risk of incision infection and are closely related to the degree of inflammation.

1. Introduction

Colorectal cancer is a common malignant tumor of the digestive system, its incidence is second only to stomach cancer, and surgical resection is the main method for the treatment of colorectal cancer. There are different degrees of preoperative digesting and absorption dysfunction, and there is the continued consumption of malignant tumor, which can make the body in a malnutrition state; the trauma caused by operation will greatly increase the basal metabolic rate and consume the nutrients in the body, which will increase the malnutrition state[1,2]. The body's nutritional status is closely related to the level of immune response, and malnutrition can suppress the specific immune response and nonspecific immune response, which further increases the occurrence risk of perioperative complications[3]. Incision infection is a common complication after colorectal cancer surgery, but there is no specific report about the relationship of perioperative nutritional status and immune function with postoperative incision infection. In the following study, the relationship of incision infection after colorectal cancer surgery with the body's nutritional status, immune function and inflammatory factors was analyzed.

2. Materials and methods

2.1. Research subjects
146 patients with colorectal cancer who received surgical treatment in our hospital between June 2013 and December 2015 were selected as the research subjects, and all patients received preoperative biopsy under colonoscopy to make clear the property of malignant tumor, were further diagnosed by postoperative pathological examination, never received preoperative chemoradiotherapy, and never used albumin preparations or immunomodulators. According to the condition of preoperative incision infection, the included patients with colorectal cancer were divided into infection group and non-infection group. Infection group (n=48) included 31 male cases and 17 female cases, they were 42–65 years old, 22 cases were with colon cancer and 26 cases were with rectal cancer; non-infection group (n=98) included 62 male cases and 36 female cases, they were 44–65 years old, 40 cases were with colon cancer and 58 cases were with rectal cancer. The general data were not significantly different between two groups of patients (P>0.05).

2.2. Serum sample collecting and detecting methods

1 d before operation, the very day after operation and 3 d after operation, 5 mL of peripheral venous blood was collected from two groups of patients respectively and then centrifuged to separate serum specimens. Serum specimens 1 d before operation and the very day after operation were taken, and automatic biochemical analyzer was used to determine hemoglobin (Hb), total protein (TP), albumin (Alb), prealbumin (PA) and transferrin (Tf) levels; serum specimens 3 d after operation were taken, and enzyme-linked immunosorbent assay kits were used to determine TNF-α, PCT, IL-1β, MCP-1 and hs-CRP levels.

2.3. Peripheral blood sample collecting and detecting methods

1 d before operation and the very day after operation, 5 mL of peripheral venous blood was collected from two groups of patients respectively, anti-coagulated with EDTA and then centrifuged to separate serum specimens. Serum specimens 1 d before operation and the very day after operation were taken; the other was centrifuged, the red blood cells at the bottom were collected, added in saline and re-suspended to incubate the fluorescent antibodies of CR1, CR3, CD58 and CD59, and then the fluorescence intensity of CR1, CR3, CD58 and CD59 were determined in flow cytometer after incubation.

2.4. Statistical analysis

SPSS20.0 software was used to input and analyze data, measurement data analysis between two groups was by independent-samples t test and the analysis within group before and after operation was by paired-samples t test. P<0.05 indicated statistical significance in differences.

3. Results

3.1. Serum nutrition–related index levels before and after operation

1 d before operation and the same day after operation, analysis of serum nutrition-related indexes Hb, TP, Alb, PA and Tf between two groups of patients was as follows: 1 d before operation and the same day after operation, serum Hb, TP, Alb, PA and Tf levels were statistically significant between two groups of patients 1 d before operation and the same day after operation (<0.05); serum Hb, TP, Alb, PA and Tf levels were not significantly different within infection group and non-infection group 1 d before operation and the same day after operation (P>0.05) (Table 1).

3.2. Peripheral blood immune cell levels before and after operation

1 d before operation and the same day after operation, analysis of peripheral blood immune cells CD3+CD4+, CD3+CD8+, CD16+CD56+ and CD19+ between two groups of patients was as follows: 1 d before operation and the same day after operation, peripheral blood CD3+CD4+, CD3+CD8+, CD16+CD56+ and CD19+ levels of infection group were significantly lower than those of non-infection group, and differences in serum Hb, TP, Alb, PA and Tf levels were statistically significant between two groups of patients 1 d before operation and the same day after operation (P<0.05); the same day after operation, peripheral blood CD3+CD4+, CD3+CD8+, CD16+CD56+ and CD19+ levels were statistically significant between two groups of patients 1 d before operation and the same day after operation (P<0.05); the same day after operation, peripheral blood CD3+CD4+, CD3+CD8+, CD16+CD56+ and CD19+ levels of both groups were significantly lower than those 1 d before operation, and differences in peripheral blood CD3+CD4+, CD3+CD8+, CD16+CD56+ and CD19+ levels were statistically significant within group 1 d before operation and the same day after operation (P<0.05) (Table 2).

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Time point</th>
<th>Hb (g/L)</th>
<th>TP (g/L)</th>
<th>Alb (g/L)</th>
<th>PA (mg/L)</th>
<th>Tf (g/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection group</td>
<td>48</td>
<td>1 d before operation</td>
<td>92.3±1.24</td>
<td>45.4±6.61</td>
<td>27.6±3.42</td>
<td>185.9±22.14</td>
<td>1.9±0.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Same day after operation</td>
<td>89.3±1.11</td>
<td>44.9±5.92</td>
<td>27.1±3.12</td>
<td>180.8±19.83</td>
<td>1.8±0.22</td>
</tr>
<tr>
<td>Non-infection group</td>
<td>98</td>
<td>1 d before operation</td>
<td>104.5±1.82</td>
<td>52.1±7.24</td>
<td>32.4±3.65</td>
<td>227.6±29.15</td>
<td>2.4±0.31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Same day after operation</td>
<td>102.7±1.92</td>
<td>52.5±7.61</td>
<td>33.0±4.25</td>
<td>230.2±33.52</td>
<td>2.5±0.35</td>
</tr>
</tbody>
</table>

*: compared between infection group and non-infection group at the same time point, P<0.05.
3.3. Peripheral blood erythrocyte immune response molecule levels before and after operation

1 d before operation and the same day after operation, analysis of peripheral blood erythrocyte immune response molecules CR1, CR3, CD58 and CD59 between two groups of patients was as follows: 1 d before operation and the same day after operation, peripheral blood erythrocyte CR1, CR3, CD58 and CD59 levels of infection group were significantly lower than those of non-infection group, and differences in peripheral blood erythrocyte CR1, CR3, CD58 and CD59 levels were statistically significant between two groups of patients 1 d before operation and the same day after operation ($P<0.05$); the same day after operation, peripheral blood erythrocyte CR1, CR3, CD58 and CD59 levels were significantly lower than those 1 d before operation, and differences in peripheral blood erythrocyte CR1, CR3, CD58 and CD59 levels were statistically significant within group 1 d before operation and the same day after operation ($P<0.05$) (Table 3).

3.4. Peripheral blood inflammatory factor levels before and after operation

3 d after operation, analysis of serum inflammatory factors TNF-α, PCT, IL-1β, MCP-1 and hs-CRP levels between two groups of patients was as follows: serum TNF-α, PCT, IL-1β, MCP-1 and hs-CRP levels of infection group were significantly higher than those of non-infection group. Differences in serum TNF-α, PCT, IL-1β, MCP-1 and hs-CRP levels were statistically significant between two groups of patients 3 days after operation ($P<0.05$) (Table 4).

4. Discussion

Postoperative incision infection is the most common complication of radical operation for colorectal cancer, perioperative nutritional status of patients with colorectal cancer is an important factor that affects the perioperative recovery, and low nutrition is related to multiple postoperative complications[4,5]. Perioperative low nutrition in patients with colorectal cancer is related to preoperative gastrointestinal absorption dysfunction, continuous malignant tumor consumption and surgical trauma-induced stress, and the most intuitive performance is that the body is in negative nitrogen balance, protein catabolism is better than anabolism, and a variety of proteins in the body are constantly consumed[6]. Hb, TP, Alb, PA and Tf are the common blood biochemical indexes that reflect the body’s protein metabolism, and poor nutrition can lead to the decreased Hb, TP, Alb, PA and Tf content[7,8]. In order to define the relationship between perioperative nutritional status and postoperative incision infection, the above serum nutrition indexes of infection group and non-infection group were analyzed in the...
study, and the results showed that 1 d before operation and the same day after operation, serum Hb, TP, Alb, PA and Tf levels of infection group were significantly lower than those of non-infection group ($P<0.05$). It means that low perioperative nutritional status is directly correlated with the occurrence of incision infection after colorectal cancer surgery, and preoperative and postoperative excessive protein consumption, body protein will affect the incision repair and healing, anti-infection and other processes, which further increase the risk of incision infection.

Low nutrition will affect the immune function, and is not conducive to the differentiation and maturity of immune cells as well as the synthesis and secretion of immunoreactive substances. CD16+CD56+NK is the important cell that mediates nonspecific immune response, and it has killing effect on the pathogen$^{[9,10]}$; CD3+CD4+T cell, CD3+CD8+T cell and CD19+B cell are the important cells that mediate specific immune response, the former can synthesize and secrete a variety of cytokines, the latter can synthesize and secrete a variety of cytotoxic substances, and together they participate in the elimination of pathogenic bacteria$^{[11,12]}$. In the study, the analysis of perioperative changes in these immune cell levels showed that the same day after operation, peripheral blood CD3+CD4+, CD3+CD8+, CD16+CD56+ and CD19+ levels of both groups were significantly lower than those 1d before operation ($P<0.05$), and peripheral blood CD3+CD4+, CD3+CD8+, CD16+CD56+ and CD19+ levels of infection group 1 day before operation and the same day after operation were significantly lower than those of non-infection group ($P<0.05$). This means that the surgical trauma and stress reaction caused by radical operation for colorectal cancer can inhibit the immune function, and the postoperative immune cell levels were significantly lower than those before operation; the low perioperative nonspecific immune response function and specific immune response function as well as the reduced immune cell levels will weaken the body’s anti-infection function, and thus increase the risk of postoperative incision infection. In recent years, studies about the body's immune function, and the change of nutritional status and immune function with perioperative poor nutritional status and inhibited immune function are associated with the massive synthesis and secretion of inflammatory cytokines in the process of incision infection.

To sum up, it can be concluded that the occurrence of incision infection after radical operation for colorectal cancer is associated with perioperative poor nutritional status and inhibited immune function, and the change of nutritional status and immune function can also affect the activation of inflammatory response and the secretion of inflammatory factors.

References


