Effect of calcium alginate dressing on the cytokine contents, collagen synthesis – degradation balance and apoptosis gene expression in the wound after perianal abscess surgery

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Objective: To study the effect of calcium alginate dressing on the cytokine contents, collagen synthesis – degradation balance and apoptosis gene expression in the wound after perianal abscess surgery. Methods: Patients with perianal abscess who received surgical resection in the Eighth Hospital of Wuhan between May 2014 and February 2017 were selected and randomly divided into the group A who received calcium alginate dressing combined with kangfuxin solution and recombinant human epidermal growth factor for dressing change and the group B who received kangfuxin solution and recombinant human epidermal growth factor for dressing change. 3 d, 6 d and 9 d after dressing change, appropriate amount of wound tissue was collected to determine the expression of cytokines, collagen metabolites and apoptosis genes. Results: 3 d, 6 d and 9 d after dressing change, TGF-β1, Smad3, EGF and bFGF protein expression as well as Col-I, Col-II, Col-III, TIMP1 and TIMP2 protein expression in wounds of both groups of patients were increasing while Fas, FasL, Bax and Caspase-3 protein expression were decreasing, and TGF-β1, Smad3, EGF and bFGF protein expression as well as Col-I, Col-II, Col-III, TIMP1 and TIMP2 protein expression in wounds of group A were significantly higher than those of group B while Fas, FasL, Bax and Caspase-3 protein expression were significantly lower than those of group B. Conclusion: Calcium alginate dressing for wound dressing after perianal abscess surgery an increase the pro-proliferation cytokine expression, adjust the collagen synthesis - degradation balance and inhibit apoptosis, and it is conducive to wound healing.

1. Introduction

Perianal abscess is a common clinical anal rectal disease, which occurs around the anus, anal canal and rectum, and will develop into anal fistula without timely treatment. Operative drainage is the first choice for clinical treatment of perianal abscess, the wound needs to be opened after operation, and affected by the particularity of anal canal and perianal structures, the occurrence risk of wound infection, delayed wound healing and other complications are high in opened wound healing. Dressing change of the wound is the effective means to promote the healing of the wound and reduce the risk of wound infection, and auxiliary local medication of kangfuxin solution and recombinant human epidermal growth factor can inhibit bacteria reproduction and promote epidermal growth[1,2]. Calcium alginate dressing is a new kind of wet dressing used for wound dressing in recent years. It has the effect of shortening the duration of exudative inflammation stage of the wound and accelerating the growth of granulation tissue and the formation of epithelium[3]. In the following studies, we analyzed the effect of calcium alginate dressings on cytokine content, collagen synthesis-degradation balance and apoptosis gene expression in wound tissue after perianal abscess surgery.

2. Case information and research methods

2.1. Case information

A total of 76 patients with perianal abscess who received surgical resection in the Eighth Hospital of Wuhan between May 2014 and February 2017 were selected as research subjects, they were with...
postoperative open wound area 6-10 cm², and the patients combined with diseases such as diabetes, tuberculosis and malignant tumor were excluded. Random number table was used to divide the 76 patients with perianal abscess into group A and group B, each with 38 cases. Group A received calcium oxalate dressing combined with kangfuxin solution and recombinant human epidermal growth factor for dressing change, including 22 men and 16 women that were 33-53 years old; group B received kangfuxin solution and recombinant human epidermal growth factor for dressing change, including 21 men and 17 women that were 32-55 years old. There was no statistically significant difference in general information between the two groups (P>0.05).

2.2. Dressing change

Two groups of patients received dressing change on a daily basis. After routine disinfection, the wound of group A was daubed with kangfuxin solution and recombinant human epidermal growth factor and then covered with calcium alginate dressings, and the wound of group B group was daubed with kangfuxin solution and recombinant human epidermal growth factor and then covered with routine sterile gauze.

2.3. Index detection

3 d, 6 d and 9 d after dressing change, adequate amount of wound tissue was collected during dressing change, added in RIPA lysate to extract the total protein in the tissue, and centrifuged in the 4 °C centrifuge for 20 min at a speed of 12 000 r/min to get the supernatant liquid, and enzyme-linked immunosorbent assay kit was used to determine TGF-β1, Smad3, EGF, bFGF, Col-I, Col-II, Col-III, TIMP1 and TIMP2 contents.

2.4 Statistical method

SPSS 21.0 software was used to input and analyze data, measurement data between two groups were compared by t test and P<0.05 indicated statistical significance in differences in test results.

3. Results

3.1 Cytokine expression in wound

3 d, 6 d and 9 d after dressing change, analysis of cytokines TGF-β1, Smad3, EGF and bFGF expression in wound was as follows: TGF-β1, Smad3, EGF and bFGF protein expression in wound of group A were significantly higher than those of group B, and Fas, FasL, Bax and Caspase-3 protein expression were significantly higher than those of group B. Differences in TGF-β1, Smad3, EGF and bFGF protein expression in wound were statistically significant between two groups of patients 3 d, 6 d and 9 d after dressing change (P<0.05).

3.2. Collagen metabolism index contents

3 d, 6 d and 9 d after dressing change, analysis of collagen metabolism indexes Col-I (ng/mL), Col-II (ng/mL), Col-III (ng/mL), TIMP1 (pg/mL) and TIMP2 (pg/mL) contents in wound was as follows: Col-I, Col-II, Col-III, TIMP1 and TIMP2 protein expression in wound of group A were significantly higher than those of group B. Differences in Col-I, Col-II, Col-III, TIMP1 and TIMP2 protein expression in wound were statistically significant between two groups of patients 3 d, 6 d and 9 d after dressing change (P<0.05).

Table 1.
Comparison of cytokine expression in wound after dressing change (ng/mL).

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Time</th>
<th>TGF-β1</th>
<th>Smad3</th>
<th>EGF</th>
<th>bFGF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>38</td>
<td>3 d after dressing change</td>
<td>3.52±0.54</td>
<td>0.89±0.11</td>
<td>2.23±0.37</td>
<td>1.03±0.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 d after dressing change</td>
<td>4.73±0.61</td>
<td>1.85±0.24</td>
<td>3.89±0.51</td>
<td>1.89±0.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 d after dressing change</td>
<td>6.64±0.79</td>
<td>3.23±0.39</td>
<td>5.63±0.77</td>
<td>3.02±0.46</td>
</tr>
<tr>
<td>Group B</td>
<td>38</td>
<td>3 d after dressing change</td>
<td>2.03±0.31</td>
<td>0.55±0.07</td>
<td>1.05±0.13</td>
<td>0.67±0.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 d after dressing change</td>
<td>2.89±0.34</td>
<td>0.93±0.12</td>
<td>1.75±0.22</td>
<td>0.99±0.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 d after dressing change</td>
<td>3.74±0.52</td>
<td>1.78±0.20</td>
<td>2.84±0.39</td>
<td>1.52±0.17</td>
</tr>
</tbody>
</table>

*: comparison of indexes between group A and group B at the same point in time, P<0.05.

Table 2.
Comparison of collagen metabolism index contents in wound after dressing change.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Time</th>
<th>Col-I</th>
<th>Col-II</th>
<th>Col-III</th>
<th>TIMP1</th>
<th>TIMP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>38</td>
<td>3 d after dressing change</td>
<td>0.67±0.08</td>
<td>0.38±0.05</td>
<td>1.32±0.18</td>
<td>79.55±39.34</td>
<td>103.45±12.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 d after dressing change</td>
<td>1.26±0.15</td>
<td>0.89±0.11</td>
<td>2.44±0.31</td>
<td>142.56±18.82</td>
<td>192.52±22.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 d after dressing change</td>
<td>1.89±0.22</td>
<td>1.52±0.18</td>
<td>3.61±0.54</td>
<td>206.74±26.82</td>
<td>268.78±31.56</td>
</tr>
<tr>
<td>Group B</td>
<td>38</td>
<td>3 d after dressing change</td>
<td>0.33±0.05</td>
<td>0.22±0.03</td>
<td>0.77±0.09</td>
<td>40.51±6.67</td>
<td>76.64±9.39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 d after dressing change</td>
<td>0.68±0.09</td>
<td>0.45±0.07</td>
<td>1.24±0.18</td>
<td>68.62±8.94</td>
<td>97.75±10.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 d after dressing change</td>
<td>0.93±0.11</td>
<td>0.72±0.09</td>
<td>1.94±0.22</td>
<td>94.51±10.25</td>
<td>142.55±17.75</td>
</tr>
</tbody>
</table>

*: comparison of indexes between group A and group B at the same point in time, P<0.05.
promote fibroblast proliferation, but also accelerate the granulation tissue formation, and the latter can directly act on fibroblasts and promote their proliferation[8,9]. EGF is a proliferative cytokine acting on epithelial cells, which can promote epithelial cell growth and accelerate wound healing[10,11]. In the study, analysis of the changes in the expression of these cytokines in wound tissue during healing process showed that TGF-β 1, Smad3, EGF and bFGF protein expression in wounds of both groups of patients were increasing, and TGF-β 1, Smad3, EGF and bFGF protein expression in wounds of group A were significantly higher than those of group B. This means that the expression of a variety of proliferative cytokines increases in wound healing process after perianal abscess surgery, and calcium alginate dressings can increase the expression of proliferative cytokines in the wound and help promote wound healing.

In wound healing process, the local tissue repair by fibroblast and epithelial cell proliferation also depends on the accumulation of extracellular matrix. Collagen is the main component of extracellular matrix, which can gradually be transformed into connective tissue and form scar healing of the wound[12,13]. Col-I, Col-II and Col-III are important types of collagen in the healed wound tissue, TGF-β 1 has a promoting effect on the secretion and accumulation of collagen, while a variety of elements in the family of MMPs degrade collagen, and are not conducive to wound healing[14]. TIMP1 and TIMP2 in the TIMPs family inhibit the activity of MMP1, MMP2, MMP9 and other MMPs on hydrolyzing collagen, which can inhibit the degradation of collagen[15,16]. In the study, analysis of the changes in the contents of these collagen metabolism indexes in wound tissue during healing process showed that Col-I, Col-II, Col-III, TIMP1 and TIMP2 protein expression in wounds of both groups of patients were increasing, and Col-I, Col-II, Col-III, TIMP1 and TIMP2 protein expression in wounds of group A were significantly higher than those of group B. This means that the collagen anabolism is enhanced and the catabolism is weakened in healing process after perianal abscess surgery, and calcium alginate dressings can regulate the balance of collagen synthesis - degradation in wound and promote wound healing.

The wound after perianal abscess surgery is infective wound, there is still persistent inflammation in the process of fester drainage, and the secretion of corresponding inflammatory factors will affect apoptosis to curb fibroblast and epithelial cell proliferation in local

### 3.3 Apoptosis gene expression

3 d, 6 d and 9 d after dressing change, analysis of apoptosis genes Fas (pg/mL), FasL (pg/mL), Bax (ng/mL) and Caspase-3 (ng/mL) expression in wound was as follows: Fas, FasL, Bax and Caspase-3 protein expression were significantly lower than those of group B. Differences in Fas, FasL, Bax and Caspase-3 protein expression in wound were statistically significant between two groups of patients 3 d, 6 d and 9 d after dressing change ($P<0.05$).

### 4. Discussion

Perianal abscess is an acute suppurative infectious disease that occurs around the anus, anal canal and rectum. Surgical resection is the common therapy, and the wound needs to be opened and receive dressing change after surgery. Kangfuxin solution and recombinant human epidermal growth factor gel are the common therapies, and the wound needs to be opened and receive dressing change after surgery. Kangfuxin solution and recombinant human epidermal growth factor gel are the common drugs for wound dressing change after perianal abscess surgery, which help to suppress bacterial growth within the wound and promote epidermal cell proliferation and wound healing. In the dressing change of complex wound, the use of wet dressing can provide suitable humid environment for wound growth, and is also conducive to dissolving the necrotic tissue, and stimulating the capillary and granulation tissue growth[4,5]. Calcium alginate dressing is a new type of wet dressing developed in recent years, the main component is the mixture of calcium ion and mannuronic acid, it can quickly absorb wound exudate and form jelly, and it helps the adhesion of microorganism and necrotic tissue in jelly and keeps the wound clean[6]. At the same time, calcium alginate dressing can accelerate the formation of granulation tissue and epithelial tissue in the wound, which is beneficial to the local wound healing[7].

Fibroblast and epithelial cell proliferation is the important biological behavior in the process of wound healing, TGF- β 1, EGF, bFGF and various other cytokines that promote proliferation are involved in the regulation of fibroblast and epithelial cell proliferation during wound healing process. TGF- β 1 and bFGF are the cytokines involved in regulation of tissue fibrosis, the former can phosphorylate downstream Smad3 molecule to not only

### Table 3.

Comparison of apoptosis gene expression in wound after dressing change.

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>Time</th>
<th>Fas</th>
<th>FasL</th>
<th>Bax</th>
<th>Caspase-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>38</td>
<td>3 d after dressing change</td>
<td>3.62±0.53</td>
<td>1.04±0.14</td>
<td>165.53±20.35</td>
<td>93.55±10.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 d after dressing change</td>
<td>2.13±0.34</td>
<td>0.77±0.08</td>
<td>112.35±12.57</td>
<td>68.76±8.24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 d after dressing change</td>
<td>1.65±0.22</td>
<td>0.48±0.06</td>
<td>70.55±8.92</td>
<td>47.62±6.72</td>
</tr>
<tr>
<td>Group B</td>
<td>38</td>
<td>3 d after dressing change</td>
<td>5.58±0.76</td>
<td>2.32±0.35</td>
<td>278.76±31.56</td>
<td>178.92±20.34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6 d after dressing change</td>
<td>4.21±0.56</td>
<td>1.67±0.20</td>
<td>203.58±27.86</td>
<td>125.47±15.68</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9 d after dressing change</td>
<td>3.25±0.44</td>
<td>1.14±0.14</td>
<td>163.56±20.25</td>
<td>97.87±10.25</td>
</tr>
</tbody>
</table>

*: comparison of indexes between group A and group B at the same point in time, $P<0.05$. 

### References

[1] Yong Lu et al. / Journal of Hainan Medical University 2017; 23(18): 65-68
lesion. Death receptor apoptosis and mitochondrial apoptosis are the important mechanisms regulating apoptosis in cells, the former starts the cascade activation reaction mediated by downstream Caspase via the combination of Fas and FasL, and the latter increases the release of cytochrome C in mitochondria through Bax and starts the cascade activation reaction mediated by the downstream Caspase. The Caspase cascade activation response eventually executes the apoptosis by activating Caspase-3. In the study, analysis of the changes in the expression of these apoptosis genes in wound tissue during healing process showed that Fas, FasL, Bax and Caspase-3 protein expression in wounds of both groups of patients were decreasing, and Fas, FasL, Bax and Caspase-3 protein expression in wounds of group A were significantly lower than those of group B. This means that the apoptosis is restrained in the wound healing process after perianal abscess surgery, and calcium alginate dressings can inhibit the expression of a variety of pro-apoptosis genes in the wound so as to inhibit apoptosis and promote wound healing.

Based on the above discussion and analysis, it can be preliminarily concluded in the study that the calcium alginate dressings facilitate the wound healing when it is used for dressing change after perianal abscess surgery; calcium alginate dressing can on the one hand, increase the expression of a variety of proliferative cytokines and increase the synthesis of collagen, and on the other hand, inhibit the apoptosis of mitochondrial pathway and death receptor pathway.

References


