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Anterior cervical plate fixation with iliac bone graft and titanium mesh for the treatment of primary suppurative cervical intervertebral space

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Abstract: Abstract: Objective to investigate the effect of one-stage anterior debridement, autogenous iliac bone graft and titanium mesh support for anterior cervical plate fixation in the treatment of primary suppurative infection of cervical intervertebral space. January 2016 to January 2020, 12 patients with primary suppurative infection of cervical intervertebral space were accepted one-stage anterior debridement, autogenous iliac bone graft and titanium mesh supporting anterior cervical plate fixation in our department, including 9 males and 3 females, with an average age of (age, 42-75, 55.5±10.23). All patients were excluded from specific infection and iatrogenic infection. Hematological examination was performed before operation, include white blood cells, hemoglobin, procalcitonin, erythrocyte sedimentation rate and CRP. Pus was taken for bacterial culture and drug sensitivity during operation, nucleus pulposus tissue. Bone tissue were sent for pathological examination to record operation time and intraoperative blood loss. Sensitive antibiotics were selected according to the results of bacterial culture and drug sensitivity test after operation. Drug sensitivity was recorded WBC, hemoglobin, procalcitonin, erythrocyte sedimentation rate and. JOA score before operation, 1 week after operation, 12 months after operation and bone graft fusion at the last follow-up were recorded. All patients completed the operation successfully and completed the 12-month follow-up. No infection recurrence occurred during the follow-up period, and the bone graft healed well. The mean operation time was (66.17±12.26) min , and the mean blood loss was (53.33±24.25) ml. The average duration of antibiotic use was (35.33±4.29) day, the average JOA score was (7.08±3.2) points before operation, while the average JOA score was (10.17 ± 2.29) points 1 week after operation, and the average JOA score was (12.5 ± 2.35) points 3 months after operation. The JOA score after operation was higher than that before operation ($P < 0.05$). The final follow-up results showed that the bone graft healed and there was no recurrence of infection. One stage anterior debridement, autogenous iliac bone graft and titanium mesh support, and anterior cervical plate fixation are safe and effective in the treatment of primary suppurative infection of cervical intervertebral space.

Keywords: Cervical spine; Anterior approach surgery; Intervertebral space suppurative infection

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1. Introduction

Primary cervical intervertebral space purulent infection is a non-specific inflammation involving the intervertebral space or disc. It has a low incidence rate in clinic. It accounts for about 3%-6%[1] of the spinal infection. The most common pathogenic bacteria are staphylococcus aureus, followed by escherichia coli and staphylococcus epidermidis. The clinical manifestations are concealed, which is very likely to cause misdiagnosis until the cervical spine appears. Severe pain, even spinal cord injury, intraspinal abscess formation can be considered cervical infection. At present, the treatment of primary cervical intervertebral space suppurative infection is mainly non-surgical treatment and surgical treatment. The non-surgical treatment methods mainly include the application of broad-spectrum antibiotics for 6 weeks, nutritional support, hyperbaric oxygen and other treatment, with slow curative effect and poor prognosis. Once the intervertebral space is destroyed, cervical instability can lead to severe neck pain, and ultimately surgical treatment is needed [2]. With the development of surgical technology, spinal surgeons pay more and more attention to surgical treatment. However, there is no consensus on the choice of anterior or posterior surgery, one-stage surgery or staged surgery. The purpose of this study is to analyze the risk factors of cervical intervertebral space infection and to explore the efficacy of this operation in the treatment of primary suppurative cervical intervertebral space infection.

2.Data and methods

2.1 General information

12 patients with primary suppurative infection of cervical intervertebral space in our hospital from January 2016 to January 2020 were selected, including 9 males and 3 females, aged 42-75 years old, with an average age of 55.5 ± 10.23 years old. Inclusive criteria: patients were diagnosed as primary cervical intervertebral space infection with anterior surgery combined with clinical and imaging data, patients with reliable follow-up and complete imaging data. Exclusion criteria: Patients with iatrogenic infection; patients with specific infection such as Brucella and Mycobacterium tuberculosis, patients with cervical metastatic tumor, patients without follow-up cooperation, patients with conservative treatment. All patients had informed consent, and this study was approved by the medical ethics committee of the

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hospital.

2.2 Case characteristics

Among the 12 patients included in the criteria, only 2 patients had fever, most patients only showed neck and shoulder pain, limited cervical rotation, flexion and extension. Among them, 3 patients were admitted to the Department of Neurology first because of their age and inflexible limb activities, 1 patient was admitted to the Department of oncology because of suspected metastasis due to previous breast cancer surgery, and 1 patient was transferred to our department after consultation. The case was diagnosed as cervical disc herniation, 3 months later, our hospital reexamined cervical instability, flexion deformity.

After entering the department, routine cervical spine anteroposterior, three-dimensional CT imaging and MRI examination were performed. If patients have primary cervical intervertebral space infection, narrowing of intervertebral space and thickening of prevertebral soft tissue shadow were found in anteroposterior position of cervical spine. In severe cases, kyphosis deformity was found. CT imaging mainly showed narrowing of intervertebral space. Destruction of end plate or vertebral bone, thickening of prevertebral soft tissue shadow showed low signal on T1 weighted image, high signal on T2 weighted image and high signal on fat pressing image, which could clearly show the degree and scope of intraspinal abscess and edema in prevertebral soft group. After admission, the patients were scored according to JOA. Routine blood routine examination, erythrocyte sedimentation rate, CRP and procalcitonin were performed and recorded. Laboratory examination results showed that the erythrocyte sedimentation rate and CRP of 12 patients were increased in varying degrees. The leukocyte count of 10 patients was increased, up to $25.2x10^9$/L. The leukocyte count of 2 patients was normal. The original calcitonin level of 11 patients was increased, and 1 patient was normal.

2.3 Preoperative preparation

The patients with positive culture results were treated with sensitive antibiotics. Those with negative culture results were treated with vancomycin. The blood routine, erythrocyte sedimentation rate and CRP were reviewed regularly. The body temperature was generally normal one week after the drug was used. The operation was considered after the erythrocyte sedimentation rate and CRP decreased significantly. Patients with spinal cord injury or even incomplete paralysis were treated with vancomycin. Patients were treated with dehydration and neurotrophic drugs.

2.4 Operation method

All patients were operated with general anesthesia. After general anesthesia, the cervical shoulder was padded with silica gel, the neck was slightly over stretched, and the head was firmly fixed with sand cushion. All patients were performed with a transverse incision on the right side of the neck, and the skin and subcutaneous tissue were cut in turn. The platysma muscle was bluntly separated, and entered along the space between sternocleidomastoid muscle and scapulohyoid muscle. The special cervical retractor was carefully pulled open to expose the prevertebral fascia, and the prevertebral fascia edema was visible after fasciotomy. Purulent fluid exudation could be seen in some patients. In most patients, the intervertebral disc was broken, part of the annulus fibrosus was separated from the endplate, the vertebral endplate was damaged. The posterior longitudinal ligament was edematous and thickened. The infected segment intervertebral disc and cartilage endplate were completely removed with nucleus pulposus forceps and curettes. Because the infection may lead to the formation of epidural abscess, it is necessary to pay attention to the incision and decompression of the posterior longitudinal ligament during the operation Protect the dura mater. If the posterior longitudinal ligament adheres to the dura mater seriously, it is not necessary to completely remove it to avoid dura mater rupture or cerebrospinal fluid leakage. During the operation, the affected vertebral body should be subtotal removed. The head, tail and both sides of the vertebral body should reach normal bone. If the wound has blood exudation, especially the diseased intervertebral disc tissue, it must be cleaned up, scraped to the bilateral uncinate cone joints, and then washed repeatedly with a large amount of normal saline. Then the autogenous iliac bone was made into bone strips and placed in the appropriate size of titanium mesh and implanted into the intervertebral space. Finally, the special titanium plate for anterior cervical spine was used to firmly fix, half tube drainage was placed and sutured layer by layer. The secretion was sent for culture, and the broken and diseased discs were sent for pathology.

2.5 Follow up

The operation time, intraoperative blood loss and antibiotic application time were recorded. The clinical efficacy was evaluated by modified Japanese Orthopaedic Association scores (JOA) score, and the modified JOA score was calculated.

All patients were followed up for 3, 6 and 12 months through outpatient appointment. Clinical and imaging examinations were performed. JOA score and laboratory examination results were recorded during follow-up, and data and imaging data were saved.

2.6 Statistical methods

SPSS 21.0 statistical software was used for statistical analysis. The data was expressed as mean ± standard

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deviation ($\bar{\chi} \pm s$). The JOA score was analyzed by paired t-test, with $P < 0.05$ as the difference.

3. Results

3.1 Operation

All the patients completed the operation successfully without serious complications. The operation time was 50-90min, with an average of (66.17±12.26) min. The intraoperative blood loss was 20-100ml, with an average of (53.33±24.25) ml. During the operation, purulent fluid exudation was found in 9 patients, but no purulent fluid exudation was found in 3 patients. In all patients, edema and thickening of the prevertebral fascia, fragmentation of the intervertebral disc, separation of large fibers, narrowing of the intervertebral space, destruction of the endplate and hypertrophy of the posterior longitudinal ligament were found.

3.2 Pathology and culture

The pathological results of 12 patients showed neutrophil infiltration and partial osteonecrosis, suggesting chronic suppurative inflammation. The pathological tissue culture results of 12 patients showed that there were 6 cases of Staphylococcus aureus, 4 cases of Escherichia coli, 1 case of Haemophilus parainfluenzae, and 1 case of culture result was negative.

3.3 Prognosis

All the 12 patients were followed up for 12 months. All the incisions healed in the first stage without infection recurrence. X-ray showed bony fusion at the last follow-up, and no loosening or fracture of internal fixation was found. Antibiotics were used for 30-42 days, with an average of (35.33±4.29) days.

3.4 Clinical efficacy evaluation

Compared with preoperative JOA score 1 week after operation, and JOA score 3 months after operation ($P < 0.05$, Table 1).

Table 1 modified JOA score at different time points ($\bar{\chi} \pm s$, ***n=12***)

	Preoperative	1 week postoperation	3 month postoperation
Modified JOA score	7.08±3.2	10.17±2.29	12.5±2.35
P		0.0127	0.0001

After 1 week, 3 months follow-up and preoperative comparison, $P < 0.05$, the difference was statistically significant.

4. Discussion

4.1 Risk factors of primary cervical intervertebral space infection

In recent years, with the acceleration of aging, the incidence of diabetes and cancer is increasing. The incidence rate of primary cervical intervertebral space infection is increasing[3]. 1 of the patients in this group have been considering metastasis after undergoing surgery for breast cancer. They continue to increase their symptoms after chemotherapy, until cervical instability occurs. The other three patients, who were older and complicated with cerebral infarction, diabetes and urinary tract infection, first went to the Department of Neurology. After symptomatic treatment, they did not get better, and gradually had decreased muscle strength of the limbs. After spinal surgery consultation, they considered cervical spine infection and received surgical treatment. Although the blood supply of human intervertebral disc is poor, and its nutrition and metabolism are mainly metabolized through the endplate, due to the supply of collateral circulation around the intervertebral disc. If there is infection in other parts or the body has poor resistance, intervertebral space infection may still occur. Once infected, it is difficult to reach the effective concentration of antibiotics alone. Some studies [4] have confirmed that antibiotics are difficult to reach the effective concentration through animal experimental models normal intervertebral disc and infected intervertebral disc to control infection. The results of this study show that diabetes, tumor and aging are risk factors of primary cervical spine infection, which is consistent with the literature reports [5].

4.2 Diagnosis and treatment of primary cervical intervertebral space infection

The incidence of primary cervical intervertebral space infection is low, and most patients complained of neck pain when they visited the clinic. Especially in the early stage, CT and X-ray examination did not change hair coloring. They were often misdiagnosed as cervical spondylosis, until the occurrence of cervical intervertebral space height loss, bone destruction and abscess formation, cervical infection [13] was considered. MRI can be used to distinguish early cervical infection. It has high signal intensity in inflammatory reaction and inflammatory edema. In addition, ESR and C-reactive protein examination for the diagnosis of primary cervical intervertebral space infection is necessary. Sometimes, some patients with normal white blood cells, ESR and C-reactive protein have increasing. Biopsy culture is still the gold standard for the diagnosis of cervical spine infection, but the positive rate is low due to the use of antibiotics on admission. There is no large number of abscesses in front of the cervical spine. All patients were diagnosed as primary cervical intervertebral space infection by cervical pain, ESR and abnormal increase of C-reactive

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Typical case: The patient's previous history of breast cancer surgery. Figure 1-2 The positive side of the cervical vertebrae shows only narrowing of the gap between the cervical 5-6 vertebrae; Gap damage is serious, a large number of abscesses formed in front of the vertebrae, and entered the vertebral tube; Figure 6-7 shows that the titanium mesh is firmly fixed; Figure 8-9 shows the last follow-up CT to show bone healing, magnetic resonance did not see signs of recurrence of infection.

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protein, typical preoperative MRI findings, postoperative pathology and culture.

There are many controversies about the surgical treatment of cervical intervertebral space infection. The main controversy is whether the first or the second stage, the front, the back or the front and back combined. Some articles [6-9] believe that the first stage of anterior surgery focus removal and complete decompression, autogenous bone graft and internal fixation with plate have the advantages of small trauma, less bleeding and less complications. However, some works show that the anterior approach of [10-11] has infection lesions. Even if it is completely removed, whether the placement of titanium mesh and anterior cervical titanium plate can cause secondary infection remains controversial. But the posterior surgery does not touch the disease which is infected with a unique advantage. Krödel [12] study show that the combined operation of anterior and posterior approaches may increase the mortality of patients. However, no matter what operation method is chosen, it is no doubt that the operation treatment is done by intravenous application of sensitive antibiotics. The results of the culture of this group show that no multiple resistant bacteria are found in Staphylococcus aureus, 4 Escherichia coli and 1 Haemophilus parainfluenza. Therefore, sensitive antibiotics are selected in the treatment, while nutrition is strengthened, self resistance is enhanced, and the combination of antibiotics is avoided. The patients in this group had 30-42d antibiotic using, average (35.33±4.29) days, which was shorter than the time of report in the literature. The main reason was early operation. Sensitive antibiotics were selected according to the culture after operation, and the hospitalization time was shortened. The first stage of this study was removed by the previous stage, and the autogenous iliac bone graft titanium mesh support and titanium plate fixation were taken. The results were accurate. The pain was obviously reduced, JOA score was improved, and no complications such as infection recurrence and internal fixation displacement were found. The first stage operation reduced the economic and mental burden of the patients. The anterior operation entered along the muscle space, with small tissue damage, less bleeding and short operation time. The infected lesions could be completely removed, and the blood supply of cervical vertebra was abundant. After the lesions such as the diseased disc and necrotic bone tissue were removed, the concentration of drugs in the vertebral body could be increased obviously. The average operation time of the patients in this group was 66.17±12.26min, and the loss of the operation was achieved. The average blood volume was 53.33±24.25mL, which was significantly better than that of posterior operation. If MRI shows that abscess enters the spinal canal, the posterior longitudinal ligament should be opened, the dural membrane should be exposed and the lesion should be washed thoroughly to avoid the omission of the infection focus. However, if the adhesion between the posterior longitudinal ligament and the dura mater is heavy, it is unnecessary to completely remove the infection. If the infection is completely washed and decompression can be achieved, the adhesion will prevent the tear of the dura mater. The patients in this group reached bone fusion until the last follow-up, and no one case of infection relapsed.

5. Conclusion

In this study, one-stage anterior debridement, autogenous iliac bone graft and titanium mesh support combined with anterior titanium plate fixation provide a surgical method for primary suppurative infection of cervical intervertebral space, but it can not replace other surgical methods.

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