DOI: 10.53469/jcmp.2024.06(10).25

Analysis of Six Cases Attached to Postoperative Infection after Shoulder Arthroscopic Rotator Cuff Repair: A Case Report

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Abstract: ***Background:*** ***The purpose of this case report was to investigate the incidence of departmental infections following arthroscopic rotator cuff repair over a three-year period as well as to compare the clinical efficacy of treating postoperative infections following rotator cuff repair using incisional debridement sutures, arthroscopic shoulder debridement and lavage treatment, and arthroscopic debridement and lavage in combination with antibiotic-cement beading.*** ***Case presentation:*** ***A retrospective evaluation of 600 shoulder arthroscopic rotator cuff repairs performed in our hospital between 2021.1 and 2023.12 was conducted to screen the data of six Chinese women aged 51-71 years, who completed routine hematological and radiological examinations after admission, were treated with antibiotics, and the use of antibiotics was adjusted according to the results of wound secretion culture. Among them, 2 cases were treated with arthroscopic debridement and irrigation of the shoulder, 2 cases were treated with arthroscopic debridement and irrigation of the shoulder combined with antibiotic cemented nails, 1 case was treated with incision and debridement and suture, and 1 case was treated conservatively. Postoperative anti-infective treatment with antibiotics was continued, and the relevant indexes were rechecked. Preoperative and postoperative follow-up were performed using the visual analog scale (VAS) and the American Shoulder and Elbow Surgeons (ASES) score.*** ***Results:*** ***The infection rate of patients who underwent rotator cuff repair during the evaluation period was 1%. Culture of wound secretions from six infected patients showed culture results of Staphylococcus aureus, Serratia marcescens, Mycobacterium xylosoxidans colorless, and Mycobacterium tuberculosis, with no obvious abnormalities, and no cultures were performed. Two cases were treated with shoulder arthroscopic debridement and irrigation, two cases were treated with shoulder arthroscopic debridement and irrigation combined with antibiotic bone cement beading, one case was treated with incision and debridement and suturing, and one case was treated conservatively. At the final follow-up, the scores of two patients treated with arthroscopic debridement and irrigation of the shoulder improved, two patients treated with arthroscopic debridement and irrigation of the shoulder combined with antibiotic-cemented beading did not show significant improvement, one patient treated with incisional debridement and suturing improved significantly, and one patient treated conservatively improved significantly.*** ***Conclusion:*** ***The overall infection rate of arthroscopic rotator cuff repair of the shoulder over 3 years was 1% (6/600). The use of incisional debridement and suturing or shoulder arthroscopic debridement and irrigation has better clinical outcomes than shoulder arthroscopic debridement and irrigation combined with cement beading for the treatment of infection after arthroscopic rotator cuff repair.***

Keywords: Rotator cuff injury, Shoulder arthroscopy, Rotator cuff repair, Postoperative infection, Retrospective analysis**.**

1. Introduction

Rotator cuff tear is one of the common shoulder joint disorders in middle-aged and elderly people, and according to statistics, its incidence accounts for about 17%-41% of the total number of shoulder joint disorders [28]. In recent years, shoulder arthroscopic rotator cuff repair has become the most commonly used surgical method for treating rotator cuff tears [4][7][8][11][18]. Although it has been shown to be very successful in the treatment of rotator cuff tears and is generally considered a safe procedure. However, the incidence of postoperative infection after shoulder arthroscopy reported in various foreign studies ranges from 0.03% to 3.4% [1][10][17][27]. Although cases of postoperative infection after shoulder arthroscopy are rare, the damage caused to the surgeon and patient after infection is enormous.

Currently, there is no uniform protocol and relevant guidelines in the relevant domestic and international literature for the treatment of postoperative shoulder arthroscopy infection. According to the relevant literature, Athwal [29] et al. used multiple incision-irrigation and debridement for the treatment of shoulder joint infections complicating rotator cuff repair in a study, and the long-term follow-up results showed that although the method was successful in eradicating shoulder joint infections, about 41% of the patients were dissatisfied with the final clinical outcome. In another study, proposed by Kunutsor [12] et al, the use of surgical debridement combined with antibiotic use to treat shoulder joint infections while preserving the built-in device can achieve a more satisfactory rate of infection control, especially for patients with symptoms of shoulder joint infection within 3 weeks after surgery, and its infection control is better than that of patients with symptoms of shoulder joint infection more than 3 weeks after surgery. Therefore, the duration of the patient's postoperative period with symptoms of shoulder joint infection is an important reference factor in the treatment process of shoulder joint infection. In addition, Zimmerli [30] et al. concluded that in patients with acute shoulder joint infections with a postoperative duration of infection of no more than 3 weeks, retention of the built-in and surgical debridement along with the use of combined antibiotics has the potential to successfully cure shoulder joint infections. Garrigues [3] et al. suggested that after irrigation combined with surgical incision and debridement for shoulder infection, antibiotics sensitive to the detected microorganisms should be selected based on

the results of microbial cultures and drug sensitivity tests in order to continue anti-infective therapy.

However, there is no experience that can be drawn from the treatment program for postoperative shoulder arthroscopy infection. Considering the above treatment experience and the fact that the anatomical structure of the shoulder joint of patients with post arthroscopic infection is relatively complete, and the infection often involves both extra-articular and intra-articular areas, and that surgical incision and debridement is generally limited to removing the infected foci under the acromion, while the intra-articular foci are more difficult to clean up, some of our patients adopted the treatment of arthroscopic debridement and irrigation of shoulder joint combined with antibiotic cement beading, which is not only conducive to the clarification of the location and extent of the infected foci, but also maximizes the effectiveness of treatment. This not only helps to clarify the location and extent of the infected foci and maximize the removal of intra-articular infected foci, but also dilutes the microbial concentration and reduces the microbial virulence through the large amount of saline irrigation under the microscope, and the placement of bone cement beads, which is able to reduce inflammation and relieve pain to a certain extent. In addition, postoperative antibiotics were selected for subsequent anti-infective treatment based on microbial culture and drug sensitivity tests. From January 2021 to December 2023, a total of 600 patients with arthroscopic rotator cuff repair were treated in our hospital, among which 6 cases of postoperative shoulder joint infection occurred, two cases were treated with arthroscopic debridement and irrigation of the shoulder joint, two cases were treated with arthroscopic debridement and irrigation of the shoulder joint combined with antibiotic cement beads, one case was treated with incision and debridement and closure of the shoulder joint, and one case was treated with conservative treatment. This study retrospectively analyzed the treatment of these six patients with the following objectives: (1) to summarize the experience of diagnosis and causative organism screening of shoulder joint infections; (2) to explore the treatment strategy and timing of surgical treatment of shoulder joint infections; (3) to compare the treatment of incisional debridement and closure with that of arthroscopic debridement and irrigation of the shoulder, and to evaluate the clinical value of the use of arthroscopic debridement and irrigation of the shoulder in combination with antibiotic cement beading for the treatment of shoulder joint infections.

2. Case Presentations

2.1 Inclusion and exclusion criteria

Inclusion criteria: (i) patients with infection after arthroscopic rotator cuff repair; (ii) treatment by incisional debridement and suturing or shoulder arthroscopic debridement and irrigation combined with antibiotic bone cement beading; (iii) the main observational indexes including the regression of infection, the degree of pain, and the shoulder function; (iv) retrospective series of case studies.

Exclusion criteria: (i) brachial plexus injury resulting in upper limb dysfunction; (ii) severe underlying disease that could not tolerate surgery; (iii) poor compliance and inability to cooperate with the treatment; (iv) incomplete clinical and imaging data and less than 3 months of follow-up.

2.2 General Information

From January 2021 to December 2023, 600 patients with rotator cuff tears were treated with arthroscopic rotator cuff repair, of whom 6 developed shoulder joint infections, with an incidence of approximately 1% (6/600). According to the inclusion and exclusion criteria, all 6 patients were included in this study, all female 6; age 61 years (range, 51-71 years).All 6 patients were clearly diagnosed with rotator cuff tear and underwent arthroscopic rotator cuff repair, and all of them developed shoulder joint infections within 1 month after the operation, and the time of the symptoms of shoulder joint infections ranged from 20 to 30 d, with an average of 27.5 d (Table 1). All four patients in this group showed different degrees of redness, swelling, and pain at the surgical site of the shoulder joint, accompanied by fever, abscess, and sinus tract formation. One patient (case 1) developed severe pain 1 month after surgery, and was treated with anti-infection for 0.5 month in our hospital; one patient (case 2) developed severe pain 1 week after surgery, and was treated with antibiotics for 0.5 month in our hospital; one patient (case 3) developed blisters in the surgical area in 1 month after surgery, and was treated with antibiotics for 1 month in our hospital; one patient (case 4) developed sinus tracts in the surgical area in 3 weeks after surgery, and was treated with antibiotics for 1 month; 2 patients (case 5,6) developed abscesses in the operative area 1 year after surgery. Our antibiotic treatment was 0.5 and 0.25 months, respectively (Table 1). After all patients developed symptoms of infection, imaging studies were performed and revealed varying degrees of bone defects at the greater tuberosity of the humerus.

Table 1: Preoperative general information and treatment of 6 patients

case	sex	age (years)	side	Duration of infection (d)	Anti-infection treatment Duration (months)	Anti-infective treatments
1	female	64	right	30	0	-
2	female	51	right	30	0.5	Cefazolin sodium injection IV (0.5 g. 1x/d)
3	female	57	left	20	1	Ceftriaxone sodium injection drip (2g.1time/d)+ meropenem injection (0.5 g, 2 times/d) IV drip
4	female	65	right	20	1	Benzoxacillin sodium injection (0.5 g. 1 time/d) + levofloxacin lactate sodium chloride injection (0.5 g. 1 time/d) intravenous drip
5	female	64	right	365	0.5	Meropenem injection IV (0.5 g, 3x/d)
6	female	71	right	365	0.25	Piperacillin sodium tazobactam sodium injection IV (4.5 g. 1x/d)

2.3 Surgical Treatments

1) Anesthesia and position

After general anesthesia, the patient was switched to the healthy lateral position with 25° of posterior tilt, 45° of abduction of the upper extremity, and 15° of anterior flexion, along with light traction of the affected extremity. Before the start of surgery, the bony contour of the affected shoulder joint and the location of the surgical access were marked on the body surface.

2) Arthroscopic exploration, irrigation

The posterior-lateral angle of the acromion was used as a landmark to locate the entry point 1.5 to 2 cm inferiorly and medially, and a standard posterior approach was established. An arthroscope with a 30° bevel was selected to enter the joint cavity through the posterior approach, and the glenohumeral structures such as the long head of biceps tendon, superior glenoid labrum, rostro-humeral ligament, superior glenohumeral ligament, anterior superior glenoid labrum, anterior inferior glenoid labrum, supraspinatus tendon stop, humeral head, and the posterior glenoid labrum were examined in turn. At the same time, the joint capsule should be well irrigated and cleaned of inflammatory synovium, necrotic tissue and other infected lesions. The arthroscope was inserted into the subacromial space through the posterior approach, and the integrity of the rotator cuff on the bursal surface and the loosening of the screws were investigated. The congested and edematous tissues and necrotic part of the tendon were cleaned up, and the internal fixation anchors were taken out after cleaning, and the grooves of the bone were examined to check whether there was any inflammation after the anchors were taken out. After the subacromial joint had been cleaned up, the area of the operation area was rinsed with large quantities of saline, and the antibiotic bone-cement beads were put in place (antibiotic was vancomycin, which had been prepared before surgery). After the subacromial joint was cleaned, the area was flushed with plenty of saline, antibiotic cement beads were placed (the antibiotic was vancomycin prepared before the operation), and a bone plug was made from the bone cement to fill in the bone groove for the anchors.

3) incise and debride

The skin was incised layer by layer along the perimeter of the acromioclavicular sinus tract up to the subacromial space, and the subacromial infected lesions were adequately debrided. After thorough debridement, the integrity of the rotator cuff on the bursal surface and screw loosening were again verified.

4) Close the incision

After completion of the layer-by-layer suture, the incision was repeatedly rinsed using saline, and then a dressing was applied.

2.4 Postoperative Treatment

Postoperative antibiotics were selected for subsequent anti-infective treatment based on the results of microbial culture and drug sensitivity tests, specifically postoperative intravenous antibiotics.

2.5 Therapeutic Efficacy Evaluation Indicators

1) Clinical manifestations and healing of sinus tracts

Clinical manifestations of shoulder joint infection mainly include local redness, swelling, heat and pain, accompanied by local abscess or sinus tract formation. When the above local symptoms disappear and the sinus tract heals, it is a clinical indicator that the infection is cured.

2) Laboratory tests and microbiologic cultures

Laboratory tests mainly include white blood cell count, erythrocyte sedimentation rate, C-reactive protein, and one or more of the above indexes are often elevated when infection occurs, and when the above indexes return to normal, they are used as laboratory measures for infection control.

Microbial culture is mainly used for screening of pathogenic bacteria and provides a reference basis for subsequent antibiotic use. Infection control is indicated when laboratory tests return to normal and microbiological cultures are negative.

3) Imaging evaluation index

A series of MRI examinations of the affected shoulder joint were performed before and after debridement and at follow-up to assess the presence of bone defects at the greater tuberosity of the humerus due to infection; the presence of bone defects at the greater tuberosity was used as an imaging criterion for surgical treatment, and the presence of further progression of bone defects at the greater tuberosity was used as an imaging assessment for infection control.

4) Visual analog scale for pain

The visual analogue scale (VAS) [9] for pain was used to assess the level of pain. In this scoring method, a horizontal line of 10 cm length is drawn on a paper, and the patient is asked to mark the line according to his/her own sensation to indicate the level of pain. Where 0 indicates no pain, 1-3 indicates mild pain, 4-6 indicates moderate pain and 7-10 indicates severe pain.

5) American Shoulder and Elbow Society Score

The American shoulder and elbow surgeons (ASES) score [24] was used to assess shoulder function. The score is divided into two parts, including the patient's self-evaluation part (subjective score) and the physician's physical examination part (objective score). In this study, only the patient's self-assessment part was selected for statistical purposes. The total ASES score was 100 points, and the higher the score, the better the shoulder function, which was generally considered to be above 70 points in the excellent range.

3. Results

3.1 General

Surgery was successfully completed in all 5 patients in this group. In 2 patients, antibiotic cement beads were placed under shoulder arthroscopy and then removed after 2 weeks. According to microbial culture and drug sensitivity test, all patients continued anti-infective treatment after surgery. 6 patients were followed up for 14, 14, 8, 4, 3, and 6 months, respectively. At the last follow-up, all patients had disappeared localized redness, swelling, oozing and other symptoms of infection in the shoulder joint, and the sinus tract of the shoulder had healed successfully without recurrence of infection.

3.2 Microbial Culture

In this group of 6 patients, 3 of them had positive microbial culture results (1 case of Staphylococcus aureus, 1 case of Serratia marcescens, 1 case of xylose-oxidizing colorless bacillus, and 1 case of Mycobacterium tuberculosis); 1 case of microbial culture results was negative, and 1 case did not undergo culture (Table 2). Meanwhile, after the microbiological culture results, according to the results of drug sensitivity and specificity tests. Targeted drug therapy was administered to the patients (Table 2).

Table 2: Postoperative follow-up time, causative organisms and anti-infective treatments in 6 patients

case	pathogenic bacteria	Anti-infective treatments	Follow-up time (months)
1	-	-	14
2	negatives	Cefazolin sodium injection IV (0.5 g. 1x/d)	14
3	Serratia marcescens	Ceftriaxone sodium injection drip (2g.1time/d)+ meropenem injection (0.5 g, 2 times/d) IV drip	8
4	Staphylococcus aureus	Benzoxacillin sodium injection (0.5 g. 1 time/d) + levofloxacin lactate sodium chloride injection (0.5 g. 1 time/d) intravenous drip	4
5	Xylose-oxidizing achromobacteria	Meropenem injection IV (0.5 g, 3x/d)	3
6	tubercle bacillus	Piperacillin sodium tazobactam sodium injection IV (4.5 g. 1x/d)	6

3.3 Laboratory Examination

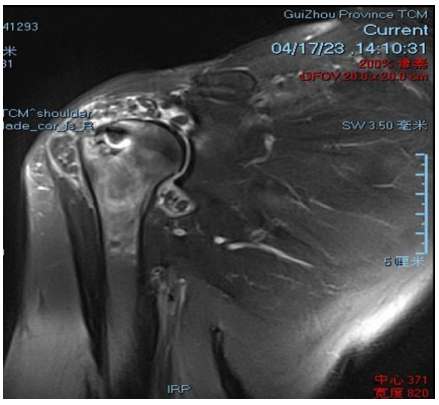
In this group, five patients with shoulder joint infection showed obvious abnormalities in their white blood cell counts before treatment. Among them, 2 patients had elevated leukocyte counts, erythrocyte sedimentation rate and C-reactive protein; 1 patient only had elevated leukocyte counts and C-reactive protein; 1 patient only had elevated leukocyte counts and erythrocyte sedimentation rate; after treatment, 5 patients had significantly decreased leukocyte counts, and erythrocyte sedimentation rate and C-reactive protein were all normal (Table 3).

Table 3: Comparison of laboratory test indices, VAS and ASES scores before debridement and at the last follow-up in 4 patients

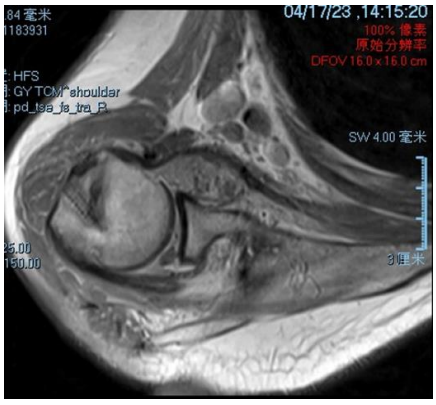
case	sex	WBC ($\times 10^9$/L)		ESR (mm/1 h)		CRP (mg/dl)		VAS		ASES	
		pre-treatment	post-treatment	pre-treatment	post-treatment	pre-treatment	post-treatment	pre-treatment	final follow-up visit	pre-treatment	final follow-up visit
1	female	3.36	3.92	8.00	9.00	0.94	0.89	6	53	2	85
2	female	11.77	5.12	17.00	15.00	7.52	1.98	6	45	2	76
3	female	6.52	5.04	22.00	9.00	4.57	1.40	5	58	2	55
4	female	13.26	7.32	61.00	32	189.45	1.05	6	53	3	55
5	female	6.14	4.82	65.00	36.00	0.46	0.01	5	43	3	67
6	female	4.93	3.32	120.00	32.00	31.43	1.52	6	50	2	65

3.4 Imaging Examination

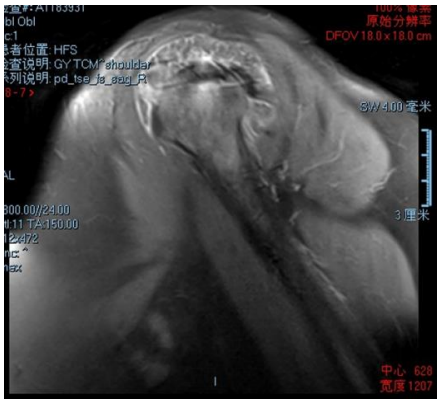
In all patients, imaging examinations revealed bone marrow edema of varying degrees at the greater tuberosity of the humerus after the development of symptoms of infection. And the imaging examination after debridement suggested that the degree of bone marrow edema at the greater tuberosity of the humerus did not increase significantly (Figure 1).



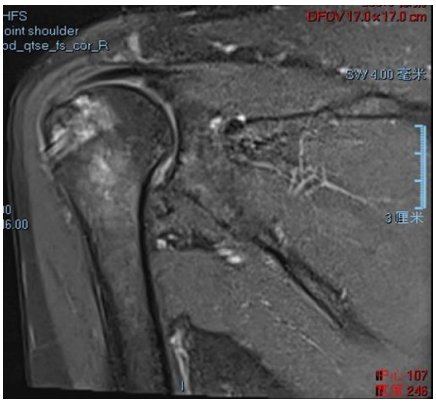
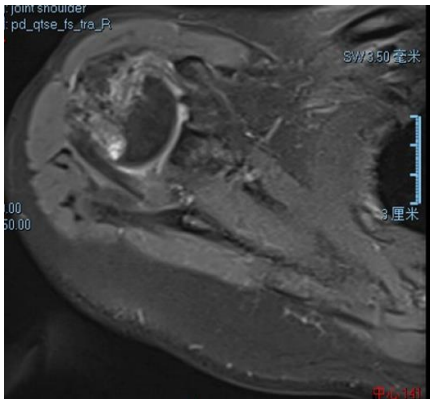
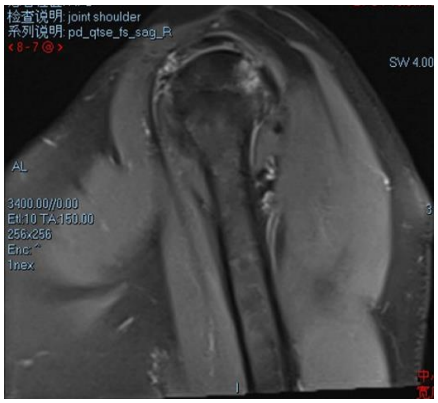
1a



1b



1c

1d 1e 1f

Figure 1: 1a, 1b, 1c: Preoperative showing postoperative changes of rotator cuff injury of the right shoulder joint, slight swelling of the soft tissues around the right shoulder joint, and bone marrow edema of the head of the right humerus and the proximal humerus .1d, 1e, 1f: Postoperative showing postoperative changes of the right humerus, and bone marrow edema changes of the proximal humerus, which did not significantly worsen compared to the previous.

3.5 VAS Score and ASES Score

Before debridement, all 5 patients had more than moderate pain in the shoulder joint and limited shoulder function. After debridement, all patients had significant relief of shoulder pain symptoms at the final follow-up, and shoulder function was also improved to different degrees. Two patients who were treated with arthroscopic debridement and irrigation of the shoulder (Cases 5 and 6) showed significant improvement in shoulder mobility and significant improvement in VAS and ASES scores (Table 3); the other two patients who were treated with arthroscopic debridement and irrigation of the shoulder combined with antibiotic-cemented beading (Cases 3 and 4) showed a poorer outcome with insignificant improvement in VAS and ASES scores after the operation. All four patients expressed dissatisfaction with the treatment results.

4. Discussion

4.1 Diagnosis and Screening of Causative Organisms for Infection after Rotator Cuff Repair Under Shoulder Arthroscopy

Clinically, the incidence of infection after rotator cuff repair is relatively low. According to the relevant literature, the probability of infection at the same site after shoulder arthroscopy is much less than that of rotator cuff repair with incision or small incision. [1] [2][5] [19] [23][25].

Currently, there is no consensus on the treatment of concurrent shoulder joint infections after rotator cuff injury. Usually, the diagnosis of shoulder joint infection requires a combination of medical history, physical examination, laboratory examination, imaging, microbial culture, and histopathologic biopsy [16][21]. The diagnostic criteria for shoulder joint infections in this study were mainly based on the Guidelines for the Prevention of Surgical Site Infections published by the U.S. Department of Health in 1999 [14][15]. All six patients in our group presented with symptoms after a single rotator cuff repair, which met the criteria of the guidelines, and were therefore definitively diagnosed with postoperative shoulder joint infection.

Since patients are usually treated with antibiotics more often when early symptoms (e.g., pain, redness, and swelling) appear, the laboratory indexes of the secretions or sinus tracts after they appear and seek medical attention, although they have a certain reference value, cannot be used as a criterion to exclude infection. According to the relevant literature, the common bacteria for infection after shoulder surgery include Staphylococcus aureus, Staphylococcus epidermidis, Streptococcus oxysporus, and Propionibacterium acnes. Among them, Propionibacterium acnes is considered to be the main causative agent leading to the development of shoulder joint infections after surgery [13][20]26]. Most scholars' studies have shown that the causative organisms causing infections during incisional surgical treatments are mostly Propionibacterium acnes because the skin surface is rich in Propionibacterium acnes [6][22]. However, when shoulder arthroscopy is used to treat rotator cuff tears, it is reasonable to assume that the bacterial type of postoperative shoulder arthroscopy infections is less associated with Propionibacterium acnes because of the small incision and fewer skin follicles involved.

In addition, in the first microbiological screening of our group of 6 patients, 1 case of Staphylococcus aureus, 1 case of Serratia marcescens, 1 case of xylose-oxidizing colorless bacillus, 1 case of Mycobacterium tuberculosis, 1 case of no apparent abnormality, and 1 case of no culture were performed. We performed a T-cell spot test for tuberculosis infection in this 1 patient with negative bacterial culture results, and ultimately found Mycobacterium tuberculosis infection. Therefore, in patients with infections after arthroscopic rotator cuff repair, we recommend prioritizing the T-cell spot test for tuberculosis infection to screen for Mycobacterium tuberculosis if the culture of bacteria and other microorganisms is negative at the time of screening for causative organisms.

4.2 Shoulder Arthroscopic Rotator Cuff Repair Surgery Infection Prevention and Treatment

The main preventive measures for infection in shoulder arthroscopy include: (i) Strictly check the white blood cell count, blood sedimentation, C-reactive protein, calcitoninogen and other indexes before surgery, and

carefully observe the surgical area or other parts of the body for the existence of potential or definite foci of infection. If definite infection foci exist, the infection should be actively controlled before surgery. For cases of possible infection, preoperative prophylactic antibiotics should be used. (ii) Aseptic operation should be strictly carried out during the operation, and for patients whose operation time is more than 3 hours, additional antibiotics should be administered once during the operation [13]. (iii) Postoperatively, incision dressing changes should be intensified and patients should be closely observed. If the possibility of deep infection is realized, surgical debridement and irrigation should be actively performed and antibiotics should be targeted according to the situation. Once infection is suspected, a thorough examination of the patient is required, including clinical symptoms, signs and laboratory tests. Bacterial cultures and imaging are rarely necessary in acute cases; in subacute or chronic cases, ultrasound and MRI are valuable in detecting periprosthetic abscess formation or identifying complications. Treatment of infection includes arthroscopic or open irrigation and debridement, and intravenous antibiotics. In our case, two patients were treated with arthroscopic debridement and irrigation of the shoulder, two patients were treated with arthroscopic debridement and irrigation of the shoulder combined with antibiotic cement beading, and one patient was treated with incisional debridement and suturing. Comparison of postoperative VAS scores and ASES scores showed that treatment with incision debridement and suturing and shoulder arthroscopic debridement and irrigation had better clinical efficacy than shoulder arthroscopic debridement and irrigation combined with cement beading for the treatment of postoperative infection after arthroscopic rotator cuff repair.

5. Conclusions

In summary, shoulder joint infection after arthroscopic rotator cuff repair is extremely rare, there is a lack of clear diagnostic criteria, and the diagnosis can be based on similar foreign criteria. When screening for pathogenic bacteria, it is common to encounter negative culture results of pathogenic bacteria, and at this time, we can consider whether there is the possibility of specific infections such as Mycobacterium tuberculosis. The following treatment principles are recommended: (i) signs of localized infection + imaging, surgical debridement is recommended; (ii) signs of localized infection + sinus tract formation + imaging, surgical debridement is strongly recommended, and perioperative antibiotic support is also required.

Abbreviations

None.

Acknowledgements

Special thanks to the newsletter author for providing this case and for his guidance and support in writing the article.

Author contributions

All authors have made substantial contributions to the conception and design of the study, data interpretation, and drafting of the article. Each of the authors has read and concurs with the content in the final manuscript.

Funding

There was no funding or sponsorship of this study.

Availability of supporting data

Not applicable.

Declarations
Ethics approval and consent to participate

Not applicable.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

None of the authors have any conficts of interest to declare

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