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ORIGINAL ARTICLE

Cutibacterium Acnes (Formerly Pripionibacterium Acnes) Incidence in Shoulder Arthroscopy and Correlation with the Clinical Status

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Abstract

Introduction: Cutibacterium acnes, formerly Propionibacterium acne, is a low virulence, aerotolerant anaerobes, Gram-positive, non-spore forming, pleomorphic bacillus. It is one of the common causes of infection that adversely affects the clinical outcome of patients, especially in implant-related infections after shoulder joint surgery. The aims of this study are to determine the incidence of C. acnes in tissue samples which were taken during shoulder arthroscopy and to compare the clinical status of patients with culture results.

Methods: Patients who had shoulder arthroscopy in our hospital between January 2016 and July 2016 were evaluated prospectively. The patient's visual analog scale score, Quick-Dash score, and Constant score were recorded before surgery and at 6th month after surgery and they were compared. Two or four samples were taken according to the shoulder pathology. Then, all of the samples were plated on 5% sheep blood agar and MacConkey agar for 14 days. Culture results and patient outcome scores compared.

Results: We have followed 39 patients who met the inclusion criteria for 6 months. Thirteen of the patients were male, and 26 were female. There were seven patients whose culture results were positive (17.9%). There was no statistically significant difference in the distribution of clinical scores according to the culture result. (Mann-Whitney U p & lt; 0.05).

Discussion and Conclusion: Despite the pre-operative skin preparation and standard antibiotic prophylaxis, shoulder arthroscopy mostly causes C. acnes inoculation, especially in the subacromial region. On the other hand, there was no difference in the clinical outcomes whether the patients developed C. acnes in tissue cultures or not. In the literature, C. acnes is associated with persistent pain and arthrosis in the shoulder region, but the results obtained in 6 month follow-ups are not compatible with this hypothesis.

Keywords: Anaerob culture; cutibacterium acnes; propionibacterium acnes; shoulder arthroscopy.

Cutibacterium acnes (C. acnes), formerly Propionibacterium acnes, is a low virulence, aerotolerant anaerobe, Gram-positive, non-spore forming pleomorphic bacilli (Fig. 1) [1]. It can be found asymptomatically in the respiratory mucosa, digestive tract, eye mucosa, and deep subcutaneous tissue as well as may cause different infections such

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as conjunctivitis, corneal ulcer, peritonitis, endophthalmitis, meningitis, septic arthritis, and prosthesis infection [2-4]. Since the hair follicles, rich in Sebaceous glands are seen intensely in the shoulder region, the shoulder joint is more frequently affected by C. acnes infection after arthroscopic and open surgeries [2].

C. acnes is thought to cause persistent shoulder pain and glenohumeral arthrosis in later years, rather than classical infection findings after transmission to the shoulder joint due to low virulence [3,5,6].

This study aims to determine C. acnes contamination rate by intraarticular tissue samples in patients, who underwent shoulder arthroscopy in our clinic. We hypothesize that the overall satisfaction of culture-positive patients in the post-operative short-term (0–6 months) follow-up is lower than culture-negative patients.

Materials and Methods

Between January 2016 and July 2016, volunteers who were indicated for shoulder arthroscopy in the outpatient clinic were evaluated prospectively. Ethics committee approval was received from Haydarpasa Numune Education and Research Hospital.

The only inclusion criteria were undergoing shoulder arthroscopy for the 1st time. Exclusion criteria were previous shoulder surgery, having received antibiotic treatment in the past 4 weeks, active skin disease on the portal entrances, and injections into the shoulder joint or subacromial space within the previous 1 year. All patients consented to participate in the study.

Fifty-four patients indicated for shoulder arthroscopy. Two patients refused to participate in the study. 1 patient who had arthroscopic decompression surgery on the same shoulder, 1 patient with diffuse acne lesions on the shoulder was elected. 2 patients with who had received antibiotherapy in the past 1 month due to urinary tract infection and tooth abscess and 2 patients who had undergone steroid injection within the past 1 year were excluded from the study.

Forty-six patients were evaluated preoperatively. "Visual Analogue Scale" (VAS) score, Quick-dash, and Constant score were calculated and compared with the post-operative 6th-month data. The same person performed pre- and post-operative examinations and evaluations. The assessor assessed without knowing the culture results of the patients. Demographic findings and comorbidities of the patients were also recorded.

1 g cefazolin antibiotic prophylaxis is applied one hour before the surgical incision as standard. 600 mg clindamycin was administered iv to those with cephalosporin allergy. All patients were prepared under general anesthesia (bench chair position). The shoulder circumference and axillary hairs of the patients were shaved with a disposable head shaver (3M surgical clipper 9671). The shaved parts were washed with an antiseptic surgical scrub containing 4% chlorhexidine gluconate. Skin preparation was performed by 7.5% w/v povidone-iodine. Standard posterior, anterior and lateral portals were used. The accessory portal was opened to the patients who had surgery due to Bankart lesion if necessary. A single-use plastic cannula was placed in all opened portals to reduce the risk of bacterial transport at repetitive inlets and outlets. Sample 1 from all patients was taken from the lower rotator interval and sample 2 from the upper rotator interval near the biceps tendon. If the patient had only labral pathology, 2 samples were taken. In patients with rotator cuff tears, samples were taken from the scholarship and the cuff (4 samples in total).

The samples were placed in a sterile syringe and labeled to be sent to the microbiology laboratory according to where they were taken (Fig. 1). All operations were performed by a single surgeon experienced in the field. Skin incisions of the patients were sutured with 2–0 prolene.

The patients were discharged 1 day after the operation. Patients were given only anti-inflammatory therapy without prescribing antibiotics during discharge. After the sampling process, the samples put into the sterile syringe and

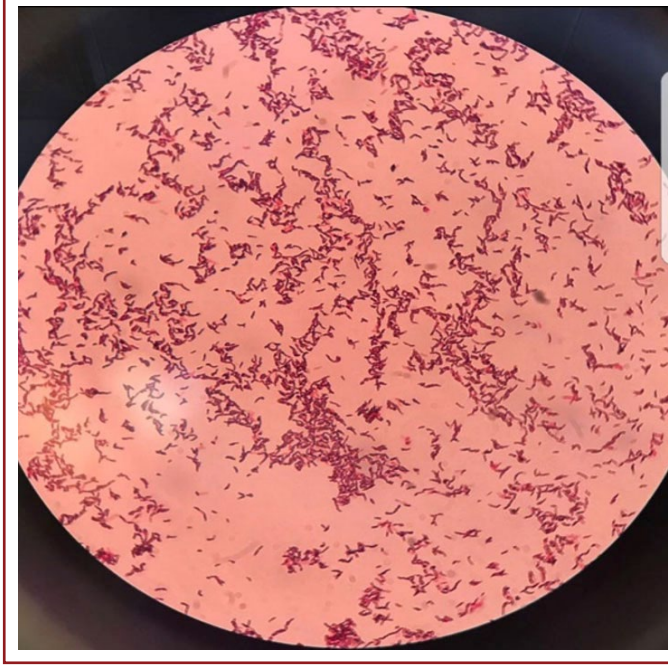

Figure 1. Gram (+) Cutibacterium acnes bacilli. (×100 magnification).

sent to the laboratory for processing within 1 h. Samples that can't be processed within 1 h excluded from the study.

Each piece of tissue that reached the laboratory was separately planted in chocolate agar, MacConkey agar, and 5% sheep blood agar (bioMérieux, France) for aerobic culture then incubated for 5 days at 37°C. For anaerobic culture, 5% sheep blood agar (bioMérieux, France) was planted in anaerobic medium (GENbag anaer, bioMérieux, France) and incubated at 37°C for a maximum of 14 days. Gram staining and catalase tests were performed on the colonies grown in anaerobic cultures. Probable catalase (+), Propionibacterium was identified at the species level by a Gram (+) bacillary automated system (MALDI-TOF mass spectrometry, bioMérieux, France).

The patients were called for polyclinic control at 2, 6, 12 weeks, and 6 months. Acute infection signs were observed in the first three controls. Quick-Dash, Constant, and VAS scores were calculated at 6th-month control. Pre-operative scores were compared.

Statistical Method

Statistical analysis of patient data was performed by a professional biostatistician.

Descriptive statistics were used to define continuous variables (mean, standard deviation, minimum, median, maximum). The comparison of the two variables which are independent and does not conform normal distribution was made by Mann Whitney U test. The relationship between two continuous variables that are not dependent on the dependent and normal distribution was examined by Wilcoxon Signed Rank test. Chi-Square (or Fisher's Exact test where appropriate) was used to explore the relationship between categorical variables. The level of statistical significance was determined as 0.05. Analyzes were performed using MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2013).

Results

About 46 patients met the inclusion criteria fort this study, 1 patient lost until follow-ups, and 6 patients were excluded from the study because more than 1 h passed between sampling and incubation period of their cultures. The mean age of 39 participants was 54.1. 26 (66%) of the patients were female, and 13 (33%) were male.

C. acnes was isolated from 7 (17.9%) of 39 patients cultures (Table 1). In 32 (82.1%) patients, there was no growth in aerobic and anaerobic cultures. Of the 7 patients with culture growth, 5 were male (71.4%), and 2 were female (28.6%) (Table 1).

In terms of gender distribution difference in culture, positivity is statistically different (p=0.030) Male patients have more culture-positive results than female (Table 1).

About 2 (66.7%) of the 3 patients who underwent shoulder arthroscopy due to recurrent shoulder dislocation had positive culture results. All 3 of these patients were male (100%). 5 of the 35 patients (14.2%) who underwent shoulder arthroscopy for rotator cuff tears. Of these 5 patients, 3 were male (60%), and 2 were female (40%). Since the n value for reproductive site and comorbidity was very small (n=1), no comparison could be made. (p-value cannot be calculated) (Table 1).

No post-operative wound infection and septic arthritis were observed in any patient. When pre- and post-operative scores were compared, the patients had statistically significant benefit from shoulder arthroscopy. Only 1 patient's post-operative (as) clinical status worsened compared to the pre-operative (bs) status (Quick-Dash score bs: 75 as: 81.8, Constant score bs: 28 as: 26, VAS bs: 5 as: 7).

Table 1. Patients data with a positive culture

Patients	Age	Gender	Sample site	Duration of incubation (days)	Surgery indication	VAS	Functional evaluation at the final follow-up	
							Q-DASH	Constant score
1	55	F	Bursa	14	RCT	1	9.09	78
2	53	M	Bursa	8	RCT	3	15.9	69
3	48	M	Rotator cuff	7	RCT	2	22.7	64
4	54	F	Bursa	8	RCT	1	18.1	47
5	41	M	Low RI & Bursa	9	RCT	2	22.7	74
6	26	M	RI	14	Instability	0	4.5	94
7	22	M	RI	14	Instability	0	2.2	92

RCT: Rotator cuff tear; VAS: Visual Analogue Scale.

Table 2. Comparison of surgical indication and gender by culture growth

	Culture (+)	Culture (-)	p
Surgical indication			
Bankart lesion	2 (28.6%)	1 (3.1%)	0.077*
RCT*	5 (71.4%)	31 (96.9%)	
Gender			
Female	2 (28.6%)	24 (75.0%)	0.030*
Male	5 (71.4%)	8 (25.0%)	

*Fisher's exact.

There was no growth in the culture of this patient.

No statistically significant difference was found in the distribution of clinical scores in pre- and post-operative 6-month controls of culture-positive and culture-negative patients (Table 3) (Mann-Whitney U p<0.05).

We took only 2 samples from the rotator interval of the patients who underwent surgery for recurrent shoulder dislocation because no intervention made to the subacromial space. Of the patients who underwent surgery due to rotator cuff tears, and their cultures were found to be positive, 4 of them had growth only in the subacromial bursa, and 1 patient had bursa and rotator cuff. The average reproduction time of C. acnes in culture is 9.9 days.

There is a statistically significant difference in culture growth rates in terms of age distribution (p=0.009) (Mann-Whitney U p<0.05). Young patients are more likely to have positive cultures.

Discussion

In this study, it was seen that C. acnes could be carried into the joint by shoulder arthroscopy. C. acnes, which was detected by culture in the joint, did not cause any joint-related infection in the 6-month follow-up and did not change the patient's clinical satisfaction significantly.

Microbiological diagnosis of anaerobic infections, which shows polymicrobial properties caused by endogenous flora, is quite difficult [7]. In routine microbiology practice, the incubation period of tissue culture samples is found to be sufficient for 5 days, but it is recommended to increase this period up to 14 days especially if anaerobic culture is requested [7-10]. In this study, we limited the culture time to 14 days. Chuang et al. They determined 19.6% C. acnes reproduction rate by increasing the culture time to 21 days. In literature, it is a common opinion that C. acnes culture should be followed for 15 days [8,10,11]. On the other hand, we believe that prolonging culture times to 21 days may affect reproduction rates in culture.

Trimble et al.,[12] were injected formalin killed C. acnes bacteria into the knees of rats and examined radiologically and histologically for 30 days. As a result, C. acnes antigens showed hyperplasia/hypertrophy, villus formation and lymphocyte aggregates in synovia. Cartilage and bone tissue erosion was observed due to the pannus tissue, and this picture was likened to rheumatoid arthritis. No similar studies have been conducted on human beings.

We believe that C. acnes is directly inoculated from the hair follicles during intra-articular surgery. However, it is suspected that the bacterium can reach the joint via the hematogenous way [5,13-16]. Dilisio et al.,[17] compared fluoroscopy-guided joint aspirate culture with arthroscopic tissue culture in 19 patients with suspected periprosthetic infection after shoulder arthroplasty. In arthroscopic tissue culture, it was reported that C. acnes was produced in significantly more patients than fluoroscopy-guided joint aspirate culture. The difference may be due to the fact that arthroscopic intervention itself carries C. acnes into the joint [18].

Table 3. Clinical score changes of culture positive and culture negative patients

Culture growth	n	Mean	Median	Standart deviation	Min	Max	p
Quick-Dash change							
+	7	25.3	34.1	17.05	2.3	45.4	0.322*
–	32	32.6	35.2	15.9	–6.8	72	
Constant change							
+	7	–21.8	–25	14.9	–42	–4	0.680*
–	32	–25.3	–22.5	12.4	–50	2	
VAS change							
+	7	3.7	4.0	1.5	1	5	0.578*
–	32	4.0	4.0	1.6	–2	6	

VAS: Visual Analogue Scale.

In our study, C. acnes grew in 2 (66.6%) cultures of 3 patients who underwent arthroscopic Bankart repair due to shoulder instability. Because of no intervention was required in the subacromial space during arthroscopic Bankart repair, no lateral portal was opened. Hudek et al.,[6] showed that being male and having a surgical incision on the anterolateral part of the shoulder was significantly more risky for C. acnes infection. The fact that all 3 (100%) of the 3 patients who underwent arthroscopic Bankart repair were male and that 2 incisions were performed for 2 anterior portals may be the most likely cause of C. acnes infection compared to the rotator cuff tear group.

Saltzman et al. compared the culture results by taking skin swabs before and after skin preparation with different solutions than those planned for shoulder surgery. Before skin preparation, coagulase-negative (–) staphylococci and C. acnes were the most common sites around the shoulder joint. The patients were divided into three groups and their skin was prepared with ChloraPrep (2% chlorhexidine gluconate and 70% isopropyl alcohol), DuraPrep (0.7% iodophor and 74% isopropyl alcohol) and povidone-iodine brush (0.75% iodine and 1.0% iodine dye). Although ChloraPrep and DuraPrep solutions were found to be statistically more effective than povidone-iodine for coagulase (–) staphylococcus elimination, no statistically significant difference was found between the 3 solutions in terms of C. acnes elimination [19].

We evaluated steroid injections in the shoulder region as an invasive procedure in the past 1 year, and we excluded 2 patients because this might affect the culture results. However, there is no statistically significant effect of the injection of the shoulder joint into the culture results is available in studies [6,20-22].

When we evaluate the patients according to their age distribution, the mean age of patients with positive culture was 42.7, and the average age of patients without culture was 56.7. In addition, 5 (38.4%) of the 13 male patients included in the study had culture, and 2 (7.6%) of the 26 women included in the study had culture. When age and sex were examined together, the risk of C. acnes reproduction was higher, especially in samples taken from the male population under 55 years of age. Man et al. showed in their study that skin sebum production is associated with the amount of dihydroepiantrosterone, a sex steroid, and that in men with the highest levels of skin sebum production in the 13–35 age range in parallel with serum testosterone levels. Women's sebum production decreases around the age of 50 in menopause [22,23].

During the 6-month follow-up period, none of our patients had surgical wound infection or septic arthritis.

Conclusion

This study was reviewed in a limited patient group (39 patients) and based on short-term follow-up (6 months). As the number of patients in the study was limited, patients could not be homogenized according to the indications of shoulder arthroscopy. Again, due to the small number of patients, the patients could not be grouped according to their additional diseases, and the culture growth and clinical infection rates related to these additional diseases could not be determined.

In conclusion, although it is not reflected in the clinic, intra-articular C. acnes inoculation may occur during shoulder arthroscopy. In patients who have undergone shoulder surgery, when there is suspicion of infection in the shoulder region, anaerobic culture should also be studied in addition to aerobic culture, and the culture duration should not be less than 14 days.

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Conflict of Interest: None declared.

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