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KLİNİK ÇALIŞMA/RESEARCH ARTICLE

FLORA 2018;23(2):64-72 • doi: 10.5578/flora.66622

Comparison of Three Surgical Treatment Methods in Acute Septic Arthritis of the Knee in Adults

Erişkin Dizin Akut Septik Artrit Tedavisinde Üç Cerrahi Yöntemin Karşılaştırılması

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SUMMARY

Introduction: *The aim of this study was to evaluate and compare patients with acute septic arthritis of the knee treated using arthroscopic method as well as 2 forms of arthrotomy.*

Materials and Methods: *Adult patients with the diagnosis of acute septic arthritis treated at our hospital with arthroscopy, conventional arthrotomy or mini arthrotomy between 2008 and 2016 were retrospectively reviewed. Clinical findings, laboratory results, hospitalization time and functional outcomes were evaluated and compared.*

Results: *Thirty-three patients were included into the present study, on whom, arthroscopic method (n= 13; 39.3%), mini-arthrotomy (n= 9; 27.2%), and conventional arthrotomy (n= 11; 33.3%) were performed. Seven of our patients required secondary surgical intervention, and our therapeutic success rate was 78%. Median hospitalization duration was 18 days (range: 7-45 days) in the arthroscopic intervention group, 16 days (range: 9-32 days) in the mini-arthrotomy group, and 11 days (range: 7-23 days) in the conventional arthrotomy group without any significant difference. Range of motion of the knee joint at the latest follow-up was similar in all groups (p= 0.736).*

Conclusion: *According to our results all 3 methods can be applied in treatment.*

Key Words: *Septic arthritis; Knee arthroscopy; Arthrotomy*

ÖZET

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Giriş: *Bu çalışmanın amacı artroskopik veya iki farklı artrotomi yöntemi ile dizde akut septik artrit tedavisi yapılan hastaları retrospektif değerlendirmek ve karşılaştırmaktır.*

Geliş Tarihi/Received: 22/01/2018 - Kabul Ediliş Tarihi/Accepted: 14/03/2018

Materyal ve Metod: *Hastanemizde 2008 ile 2016 tarihleri arasında akut septik tanısı nedeniyle artroskopi, geleneksel artrotomi veya mini artrotomi yöntemlerinden biriyle tedavi edilen erişkin hastalar geriye dönük olarak araştırıldı. Klinik bulgular, laboratuvar sonuçları, hospitalizasyon zamanı ve fonksiyonel sonuçlar değerlendirildi ve karşılaştırıldı.*

Bulgular: *Otuz üç hasta (33 diz) çalışmaya dahil edildi. 13 hasta (39.3%) artroskopik yöntemle tedavi edilirken, 9 hasta (27.2%) mini-artrotomi, 11 hasta (33.3%) ise geleneksel artrotomi yöntemi ile tedavi edildi. Yedi hastamızda ikinci bir cerrahiye ihtiyaç duyuldu ve tedavi başarı oranımız %78 idi. Ortalama hastanede kalış süresileri arasında anlamlı fark olmamakla beraber artroskopi grubunda 18 gün (aralık; 7-45 gün), mini-artrotomi grubunda 16 gün (aralık; 9-32 gün) ve geleneksel artrotomi grubunda ise 11 gün (aralık; 7-23 gün) idi. Son takiplerinde tüm grupların eklem hareket açıklıkları benzer idi (p=0.736).*

Sonuç: *Sonuçlarımıza göre tedavide her üç yöntem de uygulanabilir.*

Anahtar Kelimeler: *Septik artrit, diz artroskopisi, artrot*

INTRODUCTION

Septic arthritis is a bacterial infection in which bacteria colonize in the joint directly or through hematogenous route, and articular cartilage is injured by enterotoxins or following immune response of the host to bacteria[1]. Frequently, the knee joint is affected. Incidence of septic arthritis is presently 2 to 6/100.000 and is increasing rapidly[2,3].

In cases with delayed diagnosis or inadequate treatment, irreversible joint damage can occur within a very short time, and may result in the death of the patient[4].

Treatment should be initiated promptly. Purulent debris in the joint should be removed surgically. Antibiotherapy effective for Staphylococcus aureus and other streptococci should be initiated empirically[5,6].

Surgical removal of the purulent debris can be performed using a closed technique, such as arthroscopic approach, or open surgery, such as arthrotomy. In cases of arthrotomy, the length of the incision can be extended to expose the entire joint, or a minimal incision can be made for partial exposure of the affected joint.

The purpose of this study was to evaluate and retrospectively compare the outcomes of patients with acute septic arthritis of the knee treated using arthroscopic method as well as two forms of arthrotomy.

MATERIALS and METHODS

Patient data, who had undergone surgery with the diagnosis of septic arthritis of the knee, was collected retrospectively from the medical information system of our university hospital. Patients who had previously been treated for osteomyelitis of the distal femur or proximal tibia, those with open epiphysis, patients aged less than 18 years, cases with inflammatory arthritis, patients who had undergone debridement of the knee at another center before referral to our clinic, and patients with prosthetic infection were excluded from the study. Patients who met one of Newman's criteria (Newman A: culture positivity detected in synovial fluid; Newman B: blood culture positivity and pus from the joint during surgery; Newman C: negative joint and blood cultures but intraoperative pus or turbid fluid or histological evidence of septic arthritis) and who had clinical findings of knee pain at rest or on movement, articular swelling, erythema, increased warmth, effusion, tender joints, and laboratory test results of high C-reactive protein (CRP) level, neutrophil count, and leukocytosis were enrolled in the study.

Demographic data of the patients (age, gender, laterality), clinical findings, laboratory results, culture sensitivity of synovial fluid samples, blood culture results, time elapsed from the onset of complaints until surgery, systemic risk factors, histopathological results of the pre- and intraoperatively obtained samples, surgical technique used, length of hospital stay, and at final visit range of motions of the operated knees were calculated and recorded.

Surgical Technique and Treatment

Under general or spinal anesthesia, with the patient in the supine position, tourniquet was applied. Disinfection was performed with topical application of povidone-iodine and drapes were put in place. According to the discretion of one of four orthopedic surgeons, anteromedial or anterolateral

mini incision, which allows partial vision of the knee, or extended incision, which ensures exposure of the entire joint, was performed. In patients who underwent arthroscopy, anteromedial and anterolateral portals were used. Routinely, in all cases, samples of synovial fluid were obtained for Gram staining and culture, and irrigation with saline was performed until fluid returned to original clear color. Necrotic tissues and debris were removed. A drain was inserted through the incision before termination of the surgery, which was generally removed 24 to 48 hours later, and knee exercises were initiated. Weight-bearing was allowed as tolerated.

Intravenous cefazolin treatment was given until the results of the culture were obtained, at which time antibiotherapy based on the antibiogram was initiated and carried out for approximately 4 weeks.

Statistical Analysis

IBM SPSS Statistics for Windows, Version 19.0 (IBM Corp., Armonk, NY, USA) was used to perform statistical analyses. Descriptive statistics of continuous variables used were median, minimum, and maximum values, and categorical variables were expressed as frequencies, and percentages. Normal distribution pattern of continuous variables was tested using the Shapiro-Wilk test. Comparisons of the variables among the three groups without normal distribution were performed using the Kruskal-Wallis test. For comparisons among subgroups, Mann-Whitney U test with Bonferonni correction was applied, and for intergroup comparisons of categorical variables, Pearson chi-square test was used. P value < 0.05 was considered to be statistically significant in all statistical analyses.

RESULTS

A total of 56 patients with suspected septic arthritis of the knee aged over 18 years underwent arthroscopic or open surgery at the Department of Orthopedics and Traumatology between 2008 and 2016. Three patients with concomitant tibial osteomyelitis were excluded from the study. Six patients who did not meet any of Newman's criteria were considered cases of reactive arthritis. In two patients, sinus tract fistulas were detected close to the knee joint, and as these patients had undergone prior operations, they were considered to have chronic septic arthritis. Two patients who had been operated on previously at another center with the diagnosis of septic arthritis were referred to us upon worsening of their complaints. Clinical and laboratory information of ten patients were not adequate for our study. Overall, 33 knees of 33 patients with the diagnosis of acute septic arthritis were included into the present study; for whom, arthroscopic method (n= 13; 39.3%), mini-arthrotomy (n= 9; 27.2%), and conventional arthrotomy (n= 11; 33.3%) were performed (Figure 1).

Demographic information, clinical findings, systemic risk factors, and time interval between the onset of complaints and surgery are indicated in Table 1. Mean age of the patients in the arthroscopic intervention group was 56.6 ± 14.9 years, while it was 68.3 ± 14.9 years in the mini-arthrotomy group, and 59.5 ± 17.2 years in the conventional arthrotomy group (p= 0.248). Knee joint involvement was not associated with any other joint involvement in any case. Febrile episodes were detected in nearly one of every 10 patients in the mini-arthrotomy group at the time of admission or in anamnesis, and in nearly half of the patients in the other groups. Clinically, joint swelling, effusion, warmth, and pain were observed in the majority of the patients in all groups. Time interval between the onset of symptoms and surgery was generally less than one day in the arthroscopy and mini-arthrotomy groups, while in 45.5% of the patients in the conventional arthrotomy group, this interval ranged between one and three days. In 33.3% of the patients, no risk factor was found, while one to three risk factors were present in 45.4% of the patients, and in 21.2% of the cases, more than three risk factors were found. Smoking (33.3%) and diabetes were the most frequently seen risk factors.

Laboratory results and postoperative evaluations (2^{nd} debridement, length of stay and functional result) are summarized in Table 2. Median white blood cell count (cells/mm^3) in joint fluid aspirate obtained during preoperative period was similar in all 3 groups (p= 0.981). Median pre-

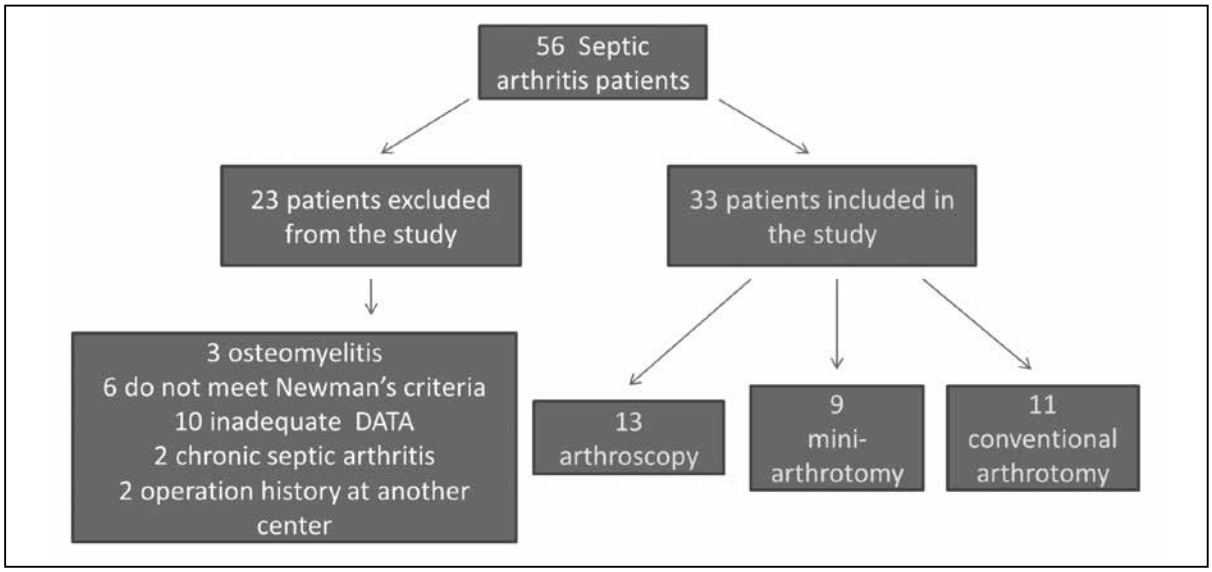

Figure 1. Flow-chart process of the patients.

operative polymorphonuclear leukocyte percentages were high, but comparable among all 3 groups (arthroscopy group: 90%; mini-arthrotomy group: 80%; and conventional arthrotomy group: 85%) (p= 0.258). Gram staining of synovial fluid samples yielded culture-positive results in a few patients: arthroscopy (n= 1), mini-arthrotomy (n= 1), and conventional arthrotomy (n= 3). In blood samples concurrently obtained from all patients, median white blood cell and neutrophil counts were high but without intergroup difference (p= 0,241 and p= 0.663, respectively). Bacterial growth was not detected in blood cultures. Median CRP values were significantly higher in the arthroscopy and mini-arthrotomy groups compared with conventional arthrotomy group, though high CRP levels and erythrocyte sedimentation rates were detected in all 3 groups (p= 0.018 and p= 0.495, respectively).

Reports of the surgical interventions were reviewed, and operating surgeons observed the presence of turbid, green-yellow synovial fluid consistent with the diagnosis of septic arthritis in 69.2% of patients who underwent arthroscopic procedure, 77.8% of those who had mini-arthrotomy, and 90.9% of those who underwent conventional arthrotomy (p= 0.431). Gram staining of the sample of the joint fluid drawn during surgery demonstrated presence of gram-positive bacteria in 7% (n= 1), 11% (n= 1), and 27% (n= 3) of the patients in arthroscopy, mini-arthrotomy, and conventional arthrotomy groups, respectively. Still culture-positivity was detected in aspirated joint fluid in 3 patients each in the arthroscopy and in the conventional arthrotomy groups (23% and 27%, respectively) and in 1 (11%) patient in the mini-arthrotomy (MSSA) group. The causative microorganisms were MSSA (methicillin-sensitive *Staphylococcus aureus*) and gram-negative microorganisms (*Escherichia coli* and *Pseudomonas aeruginosa*) in the arthroscopy group, MSSA in the mini-arthrotomy group and one MSSA, two MRSA (methicillin-resistant *S. aureus*) in the conventional arthrotomy group.

Secondary surgeries were necessary due to recurrence of the complaints within 6 months in some patients who had undergone arthroscopic debridement (2/13), mini-arthrotomy (1/9), and conventional arthrotomy (4/11).

Median hospitalization duration was 18 days (range: 7-45 days) in the arthroscopic intervention group, 16 days (range: 9-32 days) in mini-arthrotomy group, and 11 days (range: 7-23 days) in the conventional arthrotomy group without any significant difference between groups. Range of motion of the knee joint at the latest follow-up was similar in all groups (p= 0.736).

Table 1. Demographic characteristics, clinical presentation, and risk factors of the patients

	Arthroscopy group	Mini-arthrotomy group	Conventional arthrotomy group	p value
Number of patients	13	9	11	
Age* (year)	56.6 ± 14.9 (23-76)	68.3 ± 14.9 (36-84)	59.5 ± 17.2 (29-77)	0.248
Sex**				0.855
Male	8	6	6	
Female	5	3	5	
Side**				0.344
Right	8	5	4	
Left	5	4	7	
Clinical findings***				
Fever > 38.5°C	7 (53.8%)	1 (11.1%)	6 (54.5%)	0.083
Chills	2 (15.4%)	1 (11.1%)	4 (36.4%)	0.313
Swelling	11 (84.6%)	8 (88.9%)	11 (100.0%)	0.413
Erythema	7 (53.8%)	6 (66.7%)	8 (72.7%)	0.617
Effusion	12 (92.3%)	9 (100.0%)	11 (100.0%)	0.452
Warmth	13 (100.0%)	7 (77.8%)	9 (81.8%)	0.219
Pain at rest	10 (76.9%)	4 (44.4%)	8 (72.7%)	0.247
Pain on movement	13 (100.0%)	9 (100.0%)	11 (100.0%)	
Adenopathy	3 (23.1%)	0 (0%)	1 (9.1%)	0.246
Manifestations of shock	0 (0%)	0 (0%)	2 (18.2%)	0.119
Risk factors***				
Smoking	6 (46.2%)	2 (22.2%)	3 (27.3%)	0.440
Diabetes	4 (30.8%)	0 (0%)	5 (45.5%)	0.357
Chronic renal failure	0 (0%)	2 (22.2%)	0 (0%)	0.059
Intravenous drug use	3 (23.1%)	0 (0%)	0 (0%)	0.079
Liver disease	0 (0%)	2 (22.2%)	2 (18.2%)	0.219
Methotrexate treatment	0 (0%)	0 (0%)	1 (9.1%)	0.357
Malignancy	3 (23.1%)	0 (0%)	2 (18.2%)	0.313
Coronary artery disease	1 (7.7%)	0 (0%)	6 (54.4%)	0.004
Rheumatoid arthritis	1 (7.7%)	0 (0%)	1 (9.1%)	0.664
Peripheral artery disease	0 (0%)	0 (0%)	3 (27.3%)	0.037
Intraarticular steroid injection	2 (15.4%)	0 (0%)	5 (45.5%)	0.038
Immunosuppressant drug use	3 (23.1%)	0 (0%)	1 (9.1%)	0.246
Time interval between onset of symptoms and surgery (days)***				
< 1	11 (84.6%)	8 (88.9%)	6 (54.5%)	0.129
1-3	2 (15.4%)	1 (11.1%)	5 (45.5%)	

* The values are given as mean, with min-max range in parentheses.
** The values are given as the number of patients or knees.
*** The values are given as the number of patients, with the percentage in parentheses.

Table 2. Laboratory results and postoperative evaluation

	Arthroscopy group	Mini-arthrotomy group	Conventional arthrotomy group	p value
Joint aspiration sample				
White blood cell (count/mm^3)*	73.000	80.000	70.000	0.981
Polymorphonuclear WBC percentage*	90%	80%	85%	0.258
Culture-positive**	1 (7.7%)	1 (11.1%)	3 (27.3%)	0.380
Gram-positive***	2	1	2	
Blood sample				
WBC count (10^9/L)*	10.9	11.5	12.0	0.241
Neutrophil count (10^9/L)*	8.3	6.5	8.0	0.663
C-reactive protein (mg/dL)*	176	192	80	0.018
Erythrocyte sedimentation rate (mm/hours)*	96	92	57	0.495
Culture-positive**	0 (0.0%)	0 (0.0%)	0 (0.0%)	
Intraoperative infection observed**	9 (69.2%)	7 (77.8%)	10 (90.9%)	0.431
Intraoperative gram-positive***	1	1	3	
Intraoperative culture-positive***	3	1	3	
Second debridement***	2	1	4	
Hospital stay (days)****	18 (7-45)	16 (9-32)	11 (7-23)	0.165
Knee range of motion at final visit (°)*	100	110	100	0.736

WBC: White blood cell.
* The values are given as median.
** The values are given as the number of patients with the percentage in parentheses.
*** The values are given as the number of patients.
**** The values are given as median, with min-max range in parentheses.

DISCUSSION

Although septic arthritis can be seen at any age, it is more frequently observed in the elderly or very young patients with various risk factors[4]. Kaandorp et al. have followed up 7000 patients aged > 70 years for a period of 3 years. Among them, incidental septic arthritis have developed in 37 patients, and diabetes, rheumatoid arthritis, and previous joint surgery have been demonstrated to be the most important risk factors[2]. Therapeutic intra-articular corticosteroid injection has been considered another important risk factor for infection. The precise risk is difficult to quantify, but has been estimated at around 4 cases/10.000 injections cases[7]. Gupta et al. have performed a prospective study with 75 patients with a median age of 63 years who established diagnosis of septic arthritis based on culture-positive sample of joint fluid, and reported underlying joint disease in 61%[8]. Johns et al. have performed arthroscopic or open surgical debridement in 161 adult patients with diagnosis of septic arthritis with median age of 57.5 and 65.8 years, respectively. More than one comorbidity has been reported in most of the patients in the arthroscopy (62%) and open surgery (76%) groups[9]. In our study, as in the literature, mean ages of the patients in the arthroscopy, mini-arthrotomy, and conventional arthrotomy groups were 56.6

± 14.9 years, 68.3 ± 14.9 years and 59.5 ± 17.2 years, respectively. In 66% of our patients, more than 1 risk factor was found, with diabetes and smoking the most frequently seen.

In a review performed by Mathews et al., the authors have indicated that symptoms seen in septic arthritis may be milder than those observed in systemic infection[4]. Gupta et al. have observed febrile episodes in 34% of their 45 patients with culture-positive septic arthritis[8]. However, Couderc, et al. have performed a study in 105 patients with suspect septic arthritis, and indicated that chills and shivering are the most frequent admission complaints[10]. In our study, febrile episodes were found in 42.4% (n= 14) of our patients, and typically, erythema, pain at rest and movement (restricted range of joint motion) were the most frequently encountered symptoms.

Daynes et al. have evaluated the time interval from onset of symptoms until surgery and reported that surgery was performed within the first 24 hours in 48 patients, and after 24 hours in 28 patients. They added that in the latter group, hospital stay was significantly prolonged up to 4.65 days, which increased costs and the probability of chondrolysis, joint erosion, or sepsis[11]. They have also stated that the factors leading to treatment delay may include many problems encountered during the process of clinical diagnosis, preparation of the operating room, and the lack of experience of the surgical team for the operation. In our study, less than 24 hours elapsed between the onset of symptoms and hospitalization in 75.7% of our patients, and no impact on range of joint motion was seen as result of length of hospital stay.

White blood cell count, neutrophil count and percentage, CRP concentration, and erythrocyte sedimentation rate were above normal but comparable in preoperative blood and synovial fluid samples of our patients in all three groups. As indicated by Soderquist et al.[12], these findings do not provide definitive information for differential diagnosis; however, our results have demonstrated parallelism with the results of other studies cited in the literature[13,14].

Ideally, clinical diagnosis of septic arthritis should be supported by observation of bacterial growth in synovial tissue. However, bacterial growth may not be present as a result of inadequate cultivation technique, inappropriately collected sample, presence of microorganisms with lower virulence, existing fungal or mycobacterial infection, or initiation of broad-spectrum antibiotherapy in cases with suspect septic arthritis without joint aspiration[4,8,15]. Johns, et al. have indicated presence of bacterial growth in the culture of joint aspirate obtained from 83.1% of patients before surgery[9]. Helito et al. have reported bacterial growth in the culture media of 81% of 105 patients with the diagnosis of septic arthritis[16]. In our study; however, culture-positive result was obtained in preoperative knee aspirate in only 15.1% of 33 patients, and culture-positivity was not detected in concurrently obtained blood cultures. In 21.2% of the samples obtained from joint tissue during the operation, culture-positivity was observed. In the literature, various rates of culture-positive results have been reported. Lower rates of culture-positive results found in our study may be attributed to inappropriate sampling at first admission of the patients to emergency service, delayed transportation of the sample to the laboratory, or irrational use of antibiotics by our patients.

Johns et al. have compared groups of patients with diagnosis of septic arthritis for whom they performed arthroscopic or open surgical debridement, and reported a success rate of 50% and 29% in arthroscopy and open surgery groups, respectively. They have also indicated the need for second or even third debridement procedure[9]. Böhler, et al. have also compared arthroscopic and open surgical debridement groups in their study, and found need for second operation in 8 (11.4%) patients in the arthrotomy group, which was significantly higher than other group[13]. Generally, higher success rates have been reported for arthroscopic debridement (nearly 89%) in the literature compared with open debridement[17-19]. In our study, 7 of our 33 patients required secondary surgical intervention, and our therapeutic

success rate (78%) was consistent with literature findings. When compared with the other two groups, success rate was lower than that of the conventional arthrotomy group without any significant difference between groups.

Duration of hospitalization in the arthroscopic debridement and mini-arthrotomy groups was comparable to the results of previous studies[9,13]. Though not statistically significant, median hospital stay in the conventional arthrotomy group was 7 days shorter than reported results of previous studies. This may be attributable to differences in medical indications or heterogeneous distribution of comorbidities.

In the same studies, the authors have also indicated that the patients who underwent arthroscopic debridement with indication of septic arthritis had wider range of joint motion relative to those who underwent open debridement; however, in our study a distinct difference was not detected at final visit[9,13,20].

Our study had some limitations. Retrospective evaluation of patient information obtained from hospital data system precluded randomization of the patients. In addition, this was a single-center study, and four orthopedic surgeons decided the type of surgery to be undertaken. Our patient groups had quite heterogeneous comorbidities.

Although many studies have compared arthroscopic debridement and open surgery, evaluation of mini-arthrotomy in the treatment of our patients with acute septic arthritis included in the present study may provide additional contribution to the literature.

CONCLUSION

According to our experience, all three methods reviewed (arthroscopic debridement, conventional arthrotomy, and mini-arthrotomy) can be applied in treatment; however, one should be attentive to existing comorbidities.

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