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Joint irrigation and drainage in septic arthritis: A comparison of early versus late intervention and its influence on C-reactive protein normalization

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ABSTRACT

Objectives: Delay in surgical intervention for septic arthritis patients is not uncommon for various reasons. However, it is unclear if the surgical intervention delay will result in the same C-reactive protein level (CRP) normalization. Thus, this study aimed to explore the effect of management delay on the CRP level as a primary outcome and length of hospital stay as a secondary outcome.

Methods: Fifty-three patients, who underwent irrigation and drainage as part of septic arthritis management between 2015 and 2021, were identified and included upon reviewing electronic medical records. Patients were divided into two groups: Patients who underwent surgery within the first 24 h from the first medical encounter (13 patients) and those who had more than 24 h (40 patients). The effect of the time delay on CRP level was assessed after five to six weeks of irrigation and drainage.

Results: Most patients (64.2%) were male, with a mean age of 64 ± 20.7 years. Only 17 (32.1%) patients were medically free. Twelve patients had prosthetic joint infections. The mean length of the hospital stay was 22.5 ± 11.8 days. Management delay had no significant impact on the normalization of the CRP level after irrigation and drainage of the affected joint.

Conclusion: Even though there was no statistically significant effect of time delay on CRP levels between the different groups, the author cannot recommend delaying the surgical intervention for septic arthritis patients, as this study looked at CRP normalization and did not look at other factors that affect the prognosis of these patients.

Keywords: C-reactive protein, Irrigation and drainage, Length of stay, Outcome, Septic arthritis, Time delay

INTRODUCTION

Septic arthritis is a condition where joints become inflamed due to infections caused primarily by bacterial organisms such as staphylococcal and streptococcal species.[1] Occasionally, viral and fungal organisms can cause septic arthritis as well. The incidence of this condition varies between regions, with the United States and Western Europe reporting an incidence rate ranging from 5.7 to 10/100,000 population.[2-4] In comparison, Saudi Arabia has a lower incidence rate of

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2.13/100,000 population, according to a study conducted at a single center.[5] The author suggested that the reason they found a lower incidence in Saudi Arabia might be explained, in part, by the use of the Newman Grade A criteria, which are more strict than the criteria used in other studies. The common symptoms of septic arthritis include acute onset pain, redness, warmth, fever, and reduced mobility in the affected joint.[6] While confirmation of septic arthritis is done by aspiration fluid analysis from the infected joint and identifying the causative organism, diagnosis is mainly based on clinical evaluation using the patient's medical history, physical examination, and basic laboratory results.[7]

Numerous risk factors can elevate the likelihood of developing septic arthritis. Among these risk factors is age, particularly those aged 80 and above. Other potential risk factors include rheumatoid arthritis, diabetes mellitus, cancer, immunosuppressive medication use, and having prostheses.[8] Although the incidence of prosthetic joint infection (PJI) following total hip or knee arthroplasty is relatively low, estimated at 2.3% and 2%, respectively, this number has risen since the early 2000s, possibly due to antibiotic resistance.[9,10] PJI has three phases: Early infection, which happens within the first three months after joint arthroplasty and is most commonly caused by virulent microorganisms like *Staphylococcus aureus*; delayed phase, occurring between three months and two years after the arthroplasty; and caused by less virulent microorganisms such as Coagulase-negative *Staphylococcus* species; and the late phase, where the infection develops after two years and shares the same common pathogen with native septic arthritis.[11]

Failure to promptly diagnose and treat septic arthritis can lead to unfavorable outcomes.[12] Older patients, those with prosthetic joints, pre-existing joint disorders, and delayed diagnosis, are more likely to experience complications and poor outcomes. Despite treatment, the joint mechanical function may be negatively impacted in a significant proportion of patients, ranging from 25% to 50%.[13] Treatment for septic arthritis entails both medication and surgical intervention, with intravenous antibiotics aimed at the causative organism and supportive care forming the basis of medical therapy. Adequate joint irrigation and drainage are essential components of surgical intervention and have proven effective.[14]

To monitor the recovery of patients with septic arthritis, medical practitioners commonly use laboratory results such as erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and white blood cell count. While indicating ongoing inflammation, ESR may not necessarily correspond to clinical recovery.[15] As a result, it is not an ideal marker to assess recovery in patients with septic arthritis. Conversely, CRP is a more accurate marker to monitor the course of the illness, and research suggests that the normalization of CRP is associated with healing from bacterial infection.[16,17] While there may be various reasons for the delay in surgical intervention, it is unclear if it has similar outcomes to early intervention. Unfortunately, no studies have yet compared CRP levels in patients who receive early (<24 h) versus late (>24 h) surgical intervention for septic arthritis. Therefore, we proposed comparing CRP levels in septic arthritis patients, who received surgical treatment within 24 h versus those who had it after more than 24 h to determine the impact of timing on recovery.

MATERIALS AND METHODS

Study design and setting

This retrospective cohort study was conducted at a tertiary medical center with a 1500-bed capacity. This study was designed to assess the surgical outcome of patients, who had joint irrigation and drainage for septic arthritis and identify the effect of delay in joint irrigation and drainage on patients' outcomes. The patients' outcomes were defined as the length of hospital stay and normalization of CRP.

Study participants

All patients who presented with septic arthritis and had undergone irrigation and drainage as part of septic arthritis management from 2015 to 2021 were included. Pediatric patients aged ≤14 years were excluded from the study.

Data collection

The electronic medical records of patients, who met the inclusion criteria were reviewed. A customized data collection sheet was used that includes baseline characteristics, site of the affected joint, time of arrival, time of starting the irrigation and drainage, and discharge. Moreover, the data collection sheet included procedural details and patient outcomes, including CRP levels five to six weeks after surgery.

Statistical analysis

The data was analyzed using SPSS (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp). Descriptive statistics were presented as frequencies and percentages for categorical data variables. Mean and standard deviation (SD) are reported for the numerical data. The data was analyzed using cross-tabulation (Chi-square test) for data where both the predictor and the outcome were categorical. The *t*-test and analysis of variance were used to compare the means between the two groups. $P < 0.05$ was considered significant for all the statistical tests.

RESULTS

From 2015 to 2021, 53 patients underwent irrigation and drainage in Riyadh Center, and they were all enrolled in our study. Most of our patients, 34 (64.2%), were male with a mean age of 64 years and an SD of 20.7 years [Table 1]. Seventeen (32.1%) patients had normal body mass index. However, overweight and obese patients constituted 26.4% and 32.1%, respectively. Most of our patients (92.5%) were non-smokers, and six (11.3%) had recent trauma. Furthermore, only 17 patients (32.1%) were medically free, and the most common concurrent chronic diseases were diabetes mellitus, osteoarthritis, and renal failure, with a prevalence of 25 patients (47.2%), 17 patients (32.1%), and 7 patients (13.2%), respectively.

The knee was the most commonly affected joint [Table 2], with a prevalence of 47 patients (88.6%). Moreover, 12 patients (22.6%) had joint replacement surgery that led to PJI. Five patients (42.7%) developed PJI early, in the first 90 days. However, three patients (25%) had delayed PJI, more than 90 days and <2 years, whereas four patients (33.3%) developed the infection late, more than two years.

Table 1: Baseline characteristics.

Variables	*n* (%)
Age (Mean [SD])	(64 years [20.7])
Sex	
Male	34 (64.2)
Female	19 (35.8)
Body mass index*	
Underweight	5 (9.4)
Normal	17 (32.1)
Overweight	14 (26.4)
Obese	17 (32.1)
Smoker	
Yes	4 (7.5)
No	49 (92.5)
Recent trauma	
Yes	6 (11.3)
No	47 (88.7)
Comorbidities	
Yes	36 (67.9)
No	17 (32.1)
Spread of comorbidities	
Diabetes mellitus	25 (47.2)
Osteoarthritis	17 (32.1)
Renal failure	7 (13.2)
Cancer	2 (3.8)

*CDC body mass index classification was used (<18.5 kg/m^2, Underweight: 18.5–24.9 kg/m^2, Normal: 25–29.9 kg/m2, Overweight: ≥30 kg/m^2, Obese). SD: Standard deviation

Forty patients (75.4%) underwent surgery >24 h after the first medical encounter, while 13 patients (24.5%) had the surgery done in <24 h [Table 3]. The mean length of hospital stay was 22.5 days (SD 11.8).

Patients who underwent irrigation and drainage in the first 24 h had 18.8 days as a mean length of hospital stay ± 8.1 days [Table 4]. On the other hand, patients who underwent irrigation and drainage after 24 h had a mean length of stay of 23.8 ± 12.7 days, resulting in $P = 0.15$.

More than half (53.8%) of the patients who underwent irrigation and drainage in the first 24 h had normal CRP levels [Table 5]. On the other hand, 40% of patients, who

Table 2: Septic joint and prosthetic joint infection.

Variables	*n* (%)
Site of septic arthritis	*n*=53
Right knee	29 (54.7)
Left knee	18 (33.9)
Right hip	3 (5.7)
Left hip	3 (5.7)
Prosthetic joint	*n*=53
Yes	12 (22.6)
No	41 (77.4)
Classification of prosthetic joint infection	*n*=12
Early	5 (42.7)
Delayed	3 (25)
Late	4 (33.33)

Table 3: Procedure information and outcome.

Variables	*n* (%)
Time delay	
Less than 24 h	13 (24.5)
More than 24 h	40 (75.4)
Length of stay mean (SD)*	22.5 days (11.8 days)

*Patients who stayed in the hospital for reasons other than septic arthritis or its complications were excluded from the calculation of the means and SD. SD: Standard deviation

Table 4: The effect of time delay on length of stay.

	Time delay groups	
	Less than 24 h	More than 24 h
Mean length of hospital stay (SD)*	18.8 days (8.1 days)	23.8 days (12.7 days)
P-value	0.15	

*Patients who stayed in the hospital for reasons other than septic arthritis or its complications were excluded from the calculation of the means and SD. SD: Standard deviation

Table 5: Association between time delay and the normalization of CRP.

	Time delay groups		
Normal CRP*	**< 24 h**	**More than 24 h**	**Total**
No	6 (46.2%)	24 (60%)	30
Yes	7 (53.8%)	16 (40%)	23
Total	13	40	53
P-value		0.52	

*CRP <10 mg/L was deemed as normal. CRP: C-reactive protein

underwent irrigation and drainage after 24 h experienced normalization of CRP level with $P = 0.52$.

DISCUSSION

As far as the authors are aware, this study is the initial one to compare CRP levels in septic arthritis patients who underwent early (<24 h) and late (>24 h) surgical intervention. This study compared the CRP level of 53 patients, who had undergone joint irrigation and drainage in <24 h, and those who had undergone it after 24 h from the diagnosis of septic arthritis. The two groups did not show a significant difference in the normalization of CRP levels.

Past research emphasizes that early diagnosis and treatment are crucial in avoiding long-term functional impairments and reducing the likelihood of cartilage damage from joint arthrosis. Vispo Seara *et al.* demonstrated that the functional outcome of septic arthritis is influenced by several factors, including the patient's age, joint condition, and the duration between symptom onset and surgical intervention.[18] In addition, Balabaud *et al.* determined that the time interval between symptom onset and surgical treatment is the most significant prognostic factor in patients with septic arthritis. They proposed timely and aggressive arthroscopic debridement.[19]

Another study by Kodumuri *et al.* also found no significant difference in intensive care unit (ICU) admission and mortality between patients with delayed surgical intervention (>24 h) and those with early intervention (<6 h).[20] Therefore, it appears that delaying joint irrigation and drainage in septic arthritis patients does not affect ICU admission, mortality, or CRP normalization. Although the difference in the mean length of hospital stay between the two groups was not statistically significant, patients treated >24 h had a longer stay (23.8 ± 12.7 days) compared to those treated <24 h (18.8 ± 8.1 days) [Table 4], this difference may still have clinical significance.

Our study has some limitations worth noting. First, its retrospective design restricts the data collection to what was already recorded in the electronic medical reports of the patients. In addition, the sample size of our study was small, consisting of only 53 patients, which may have hindered the ability to detect statistical significance between the groups. Moreover, randomized controlled trials are generally considered to have a stronger level of evidence than retrospective cohort studies. However, conducting randomized-controlled trials may be ethically challenging, as it is considered unethical not to provide patients with an intervention that is believed to be superior to another intervention, which is why most studies in this area are observational.[21-24] As a result, further studies with larger sample sizes are necessary to establish the significance of the time delay of surgical intervention on patients' outcomes.

CONCLUSION

The findings revealed no discrepancy in CRP values between the two groups. While the outcome suggests that postponing surgical intervention did not affect CRP levels, the authors do not recommend delaying the intervention in these patients, as this study looked at CRP normalization and did not look at other factors that may affect the prognosis of these patients. However, this study showed that it could be done safely if it was necessary to delay the intervention for a good reason. Additional investigations are warranted to evaluate the short- and long-term consequences. A more extensive sample size and prospective studies are advised to assess the actual impact.

RECOMMENDATION

Further research with a larger sample size is warranted to ascertain the result of the present study.

AUTHOR'S CONTRIBUTIONS

AAT, MKA, ALB, SMW, and AAH contributed to the concepts, design, definition of intellectual content, literature search, clinical studies, experimental studies, data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing, and review. All authors have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

ETHICAL APPROVAL

The study is approved by the King Abdullah International Medical Research Center, number NRC21R/245/06, dated 06/14/2021.

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY FOR MANUSCRIPT PREPARATION

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

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