



Effects of Saline Irrigation and Oral Antibiotics Therapy on Acute Presentation of Late Infected Total Knee Arthroplasty

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Abstract

Purpose: The purpose of our study was to evaluate the effectiveness of the syringe saline irrigation coupled with oral antibiotic management in acute presentation of late infected total knee arthroplasty.

Methods: From January 2014 to December 2017, 15 patients with acute presentation of late infected total knee arthroplasty were treated with syringe saline irrigation and oral antibiotics according to bacterial sensitivity or with empiric antibiotics if no bacteria were isolated from the cultures. The medical records were reviewed to determine the effectiveness of the syringe saline irrigation coupled with oral antibiotic management.

Results: There were three men and 12 women, with a mean age of 72.6 years (range, 61 to 79). Ten (67%) patients preserved their total knee prosthesis with an average follow-up of 47 months (range, 29 to 66 months). Five patients failed the saline irrigation protocol and four patients underwent two-stage revision arthroplasty and one patient passed away during the perioperative period after revision surgery. Methicillin-Resistant *Staphylococcus aureus* was identified in 2 patients. No complications related to saline irrigation coupled with oral antibiotic therapy were encountered.

Conclusion: Syringe saline irrigation coupled with oral antibiotic management is an effective procedure for patients with acute presentation of late infected total knee arthroplasty.

Keywords: Syringe saline irrigation; Antibiotics; Infected total knee arthroplasty; Acute presentation; MRSA

Introduction

Infection following Total Knee Arthroplasty (TKA) is one of the most challenging complications and it is not easy to cure. The prognosis of infected TKA varies greatly depending on the causative microorganisms and treatment methods [1]. Infection of TKA occurs in between 1% and 5% of patients [2-7]. With the increment of frequency of TKA in elderly population, the incidence of postoperative infections has also increased [8,9].

Managements of infected TKA used several options such as chronic antimicrobial therapy [10,11], Irrigation and Debridement (I&D) combining with component retention [12-14], one- or two-stage revision arthroplasty [15-17], salvage treatments such as joint arthrodesis, amputation and resection arthroplasty [18-20]. Among these options, two-stage revision arthroplasty is considered an optimal standardized protocol with a success rate ranging from 85% to 95% [21,22]. However, two-stage revision arthroplasty is associated with joint stiffness, pain between stages, economic burden, bone defects, soft tissue loss and prolonged stay in hospital [10,23,24].

In addition, standard procedures including two-stage revision arthroplasty are sometimes impossible to perform due to patient's medical conditions and/or refusal of surgical intervention. Therefore, less invasive procedures such as irrigation and debridement with retention of implant are possible treatment options in acute or subacute infections [10,11,25,26].

We experienced that syringe saline irrigation coupled with oral antibiotics shows possible efficacy to treat patients with acute presentation of late infected total knee arthroplasty. However, few studies have specifically addressed saline irrigation coupled with oral antibiotic management of infected TKA.

Therefore, we designed a retrospective observational study. The purpose of this study was to

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determine the effectiveness of the syringe saline irrigation coupled with oral antibiotic management in acute presentation of late infected total knee arthroplasty.

Materials and Methods

The design and protocol of this retrospective study were approved by the institutional review board in our hospital, which waived the informed consents.

From January 2014 and December 2017, 15 patients with infected TKA within 1 week after symptom onset were treated by syringe saline irrigation coupled with oral antibiotic management at our hospital. The inclusion criteria were patients with (1) primary TKA, (2) infections classified as the late hematogenous type [27], and (3) saline irrigation procedure performed within 1 week after the onset of symptoms of infection. Infected TKA was confirmed by aspirated joint fluid analysis, which is done by microbiological culture or demonstration of acute inflammation by periprosthetic tissue, or a WBC count of $>2,000/\mu\text{L}$ or granulocytes percentage of $>70\%$ in joint fluid [28]. Laboratory studies included a complete blood-cell and differential count, Erythrocyte Sedimentation Rate (ESR), and C-Reactive Protein (CRP) level. Joint fluid was obtained preoperatively and intraoperatively to confirm the presence of causative organisms. The clinical results were also reviewed in terms of recurrence.

Demographic and clinical data, including gender, age, initial diagnosis, symptom onset, time from TKA, follow-up period, laboratory results such as ESR, CRP, joint synovial WBC and identified bacteria in culture, were obtained by reviewing the medical records (Table 1). The mean age at the time of syringe irrigation procedure was 72.6 years (range, 61 to 79 years) and there were three males and thirteen females. Primary diagnoses for the initial TKAs were osteoarthritis in all patients. The mean time interval between syringe irrigation procedure and TKA was 47.8 months (range, 12 to 127 months). The mean follow-up period was 47 months (range, 29 to 66 months).

Saline Irrigation Technique

All patients are placed in a supine position on an operating room table and should extend their leg with 20 degrees of knee flexion with a towel roll under the knee. Saline irrigation is carried out without general or spinal anesthesia. After sterile prep, the doctor should identify the location of patella and an 18-gage needle is inserted to 1 cm lateral and 1cm superior on the knee during the suprapatellar approach following local anesthesia (Figure 1). Vancomycin 500 mg is mixed to the 500cc normal saline solution (We split 500cc of saline into 50cc syringes and made ten). And then saline irrigation is performed to aspirate repeatedly synovial fluid from a knee joint cavity after injecting vancomycin mixed saline. The attempts were made repeatedly to aspirate as much injected saline as possible. After irrigation was performed using 500cc vancomycin mixed saline solution (up to 1000cc in some case), the 18-gage needle was removed from the knee joint and a bandage was placed over the insertion site. We applied compression dressing with immobilizer to the lower leg. During the microorganism culture test, we used empirical venous antibiotic and oral rifampin until the symptoms improved, and if the symptoms did not improve, saline irrigation was performed two to three times at intervals of 5 to 7 days.

After being discharged, all patients received oral antibiotics treatment for at least six weeks according to the general treatment

protocol. Broad spectrum antibiotics including third generation cephalosporin, ciprofloxacin and rifampin were chosen [29]. In case of non-responder of antibiotics regimen, the antibiotics were changed depending on antibiotics sensitivity test. The mean duration of the oral antibiotic therapy was 9.3 weeks (range, 6 to 15 weeks).

Patients underwent clinical and radiographic follow-ups at post-irrigation 2 weeks, 6 weeks, 3, 6, 9, 12 months, and 6 months thereafter. Patients who had not returned for regularly scheduled visits were contacted by telephone. Clinical evaluations were performed using Knee Society scores [30]. Radiographic analysis included a weight bearing AP view, non-weight bearing AP, lateral view at 30 degrees of flexion, and skyline patellar view. We assessed all radiographs using the Knee Society radiographic scoring system to evaluate component alignment and radiolucencies around the component [30]. Mortality status was determined using hospital records and/or by interviewing the patient's family. Successful treatment was defined as no clinical infection signs and the normal level of CRP at every outpatient follow-up.

Results

Infections were eradicated by a saline irrigation procedure in 10 out of 15 patients (67%, Treatment success group). Four patients underwent two-stage revision arthroplasty following the saline irrigation procedure due to uncontrolled infections and one patient died during two-stage revision arthroplasty due to medical problems (Treatment failure group). The median duration of symptoms prior to the saline irrigation procedure was 4.4 (2 to 7) days. Synovial fluid cultures yielded positive findings in 6 of the 15 patients, and Methicillin-Resistant *Staphylococcus aureus* (MRSA) was identified in the all two. MRSA was only identified in the treatment failure group. Of the 9 patients with a negative culture, four had received oral or intravenous antibiotics elsewhere before this procedure. Patients received oral antibiotic therapy, according to bacterial sensitivity, or empiric antibiotics if no bacteria were isolated from the cultures for 4 to 6 weeks after the procedure.

The mean Knee Society knee score improved from 27.5 points preoperatively (range, 15 to 50 points) to 86.5 points at the final follow-up (range, 65 to 100 points) in the 10 patients (Treatment success group) with a minimum follow-up of 2 years. The mean preoperative function score improved from 35.5 points (range, 10 to 55 points) to 81.5 points (range, 60 to 100 points) at final follow-up. A non-progressive radiolucent line (a radiographic demarcation of ≥ 2 mm) was not observed during a series of follow-up. The median



Figure 1: The 18-gage needle is placed to 1cm lateral and 1cm superior point on patella.

Table 1: Patients demographics.

| Patient No. | Sex/Age (yr) | Initial diagnosis | Symptoms onset (days) | Time from TKA (months) | Follow-up period (months) | ESR (mm/h) | CRP (mg/dl) | Synovial fluid WBC (/ μ L) | Culture | Others |
|-------------|--------------|-------------------|-----------------------|------------------------|---------------------------|------------|-------------|--------------------------------|--------------------------|---------------------------------|
| 1 | F/75 | OA | 4 | 61 | 66 | 89 | 19.12 | 26560 | Salmonella species | |
| 2 | M/76 | OA | 3 | 49 | 61 | 26 | 23.65 | 44160 | No growth | |
| 3 | F/70 | OA | 5 | 18 | 55 | 113 | 8.46 | 50000 \uparrow | No growth | |
| 4 | F/79 | OA | 5 | 58 | 53 | 51 | 10.47 | 50000 \uparrow | Streptococcus salivarius | |
| 5 | M/78 | OA | 2 | 23 | 52 | 79 | 23.65 | 50000 \uparrow | No growth | |
| 6 | F/68 | OA | 6 | 87 | 51 | 77 | 25.26 | 12960 | No growth | |
| 7 | F/69 | OA | 6 | 12 | 48 | 79 | 1.9 | 15320 | No growth | Two-stage revision arthroplasty |
| 8 | F/69 | OA | 4 | 17 | 44 | 6 | 25.57 | 8800 | MRSA | Two-stage revision arthroplasty |
| 9 | F/79 | OA | 3 | 99 | 32 | 114 | 7.38 | 42720 | No growth | |
| 10 | F/69 | OA | 3 | 107 | 37 | 43 | 9.2 | 13120 | No growth | |
| 11 | F/73 | OA | 7 | 14 | 34 | 93 | 15.37 | 33120 | No growth | Two-stage revision arthroplasty |
| 12 | F/69 | OA | 6 | 127 | 34 | 110 | 10.83 | 4000 | No growth | |
| 13 | M/78 | OA | 5 | 20 | 3 | 120 | 15.96 | 23040 | MRSA | Died at 3 months |
| 14 | F/76 | OA | 3 | 12 | 30 | 120 | 10.61 | 21120 | MSSA | Two-stage revision arthroplasty |
| 15 | F/61 | OA | 4 | 13 | 29 | 63 | 13.83 | 13920 | MSSA | |

OA: Osteoarthritis; TKA: Total Knee Arthroplasty; ESR: Erythrocyte Sedimentation Rate; CRP: C-Reactive Protein; WBC: White Blood Cell; MRSA: Methicillin-Resistant *Staphylococcus aureus*; MSSA: Methicillin-Sensitive *Staphylococcus aureus*

Table 2: Comparison between I/D and retention and saline irrigation.

| Author(s) (Year) | Treatment options | General or spinal anesthesia | Number of cases | Success rates (%) | Mean follow-up (months) | Other |
|-----------------------------|-------------------|------------------------------|-----------------|-------------------|-------------------------|-----------------------------------|
| Schoifet & Morrey 1990 [35] | I/D and retention | O | 31 | 23% | 96 | |
| Teeny et al. 1990 [36] | I/D and retention | O | 21 | 29% | 48 | |
| Hartman et al. 1991 [32] | I/D and retention | O | 33 | 39% | 54 | 21 primary TKA 12 revision TKA |
| Brandt et al. 1997 [31] | I/D and retention | O | 33 | 36% | 78 | 26 primary TKA 7 primary THA |
| Mont et al. 1997 [34] | I/D and retention | O | 24 | 71% | 60 | 22 patients |
| Kim et al. 2015 [33] | I/D and retention | O | 28 | 61% | 40 | |
| Present study | Saline irrigation | X | 15 | 67% | 47 | |

I/D: Irrigation and Debridement; TKA: Total Knee Arthroplasty; THA: Total Hip Arthroplasty

duration of follow-up was 47 months (range, 29 to 66 months). No recurrence of infection occurred in 10 patients during the study period.

Discussion

The most important finding of the present study was that the syringe saline irrigation coupled with oral antibiotic management is a safe and effective procedure for infected TKA.

Several studies have reported the results of open irrigation and debridement with component retention to salvage the implant and minimize morbidity [31-36]. The early success rate of this procedure was an approximately 20% to 40% [31,32,35,36]. Later Kim et al. [33] reported 61% success rate and Mont et al [34]. 71% after applying restricted indications. These findings corresponded with survival rates of this study. In this study, syringe saline irrigation coupled with oral antibiotic management showed a relatively high success rate of 67% (Table 2). Syringe saline irrigation would play a role similar to one that open irrigation and debridement play and the addition of oral antibiotics may improve the effectiveness of this procedure.

Here is the background behind our choosing antibiotics. Moon et al. reported that the common microorganism of infected TKA in

Korea was MRSA [37,38] and vancomycin is added to the normal saline solution. Also, Rifampin is effective against the implant-associated infections caused by *Staphylococci* and *Propionibacterium* spp., whereas ciprofloxacin has biofilm activity against gram-negative bacteria [39].

The syringe saline irrigation and oral antibiotic therapy has several distinct advantages. First and foremost, if a patient refuses surgery or a surgical treatment can put a patient's life at risk, it offers not only non-invasive, but also alternative therapeutic strategy for infected TKR. This procedure makes it possible to avoid a general or spinal anesthesia for a patient, and to perform therapeutically irrigation without medical problems. Second, complications associated with surgery can be avoided, maintaining stability of the knee after this procedure. Therefore, we propose that syringe saline irrigation coupled with oral antibiotic management can be performed within seven days after the onset of symptoms before definite biofilm formation.

However, this study has several inevitable limitations. First, this study was a retrospectively designed and performed on a small number of patients and the number of the treatment failure patients was relatively small, rendering statistical comparison difficult.

However, the study could not be prospectively randomized because it is not a proven procedure as a treatment option of infected TKA. Second, although the follow-up period was a minimum of 24 months, a short-term follow-up period might not be enough to confirm long-term effects and not guarantee the prevention of recurrence at long-term follow-up. Third, this study included only saline irrigation group, lacking the evaluation of its usefulness through comparison with other treatment options such as irrigation and debridement with component retention. Further research will be necessary in the future to validate our procedure including control groups. Finally, patients presented with less complicated history related to success rate of infection control.

Nevertheless, these limitations, this study demonstrated that syringe saline irrigation coupled with oral antibiotic management is a safe and effective procedure in patients with acute presentation of late infected total knee arthroplasty.

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