Original Article

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Evaluation of the Effectiveness of Local Teicoplanin in Diabetic Tibia Plafond Fractures

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Abstract

Objective: The aim of this study is to evaluate the effectiveness of local teicoplanin (TEC) administration in diabetic patients who underwent surgery for tibial plafond fracture.

Methods: We retrospectively evaluated the records of 22 diabetic patients who underwent osteosynthesis with open reduction plate–screw fixation due to tibial plafond fractures between January 2007 and January 2016. The cases were divided into two groups as teicoplanin group (Group T, n=12) and control group (Group C, n=10) based on perioperative administration of 400 mg TEC. In addition to demographic data, both groups were compared for the American Society of Anesthesiologists (ASA) score, duration of operation, length of hospital stay (LOS), post-surgical infection, and rates of reoperation and amputation.

Results: There was no significant difference in preoperative demographic data and ASA scores between both groups. Although there was no significant difference between the two groups in terms of superficial wound infection, the rates of deep wound infection, reoperation, and LOS in Group C were significantly higher than those in Group T.

Conclusion: Perioperative local TEC administration in diabetic patients who underwent surgery for tibial plafond fracture seemed to be effective for deep wound infection, reoperation, and LOS.

Keywords: Teicoplanin, tibia plafond fracture, post-surgical infection

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INTRODUCTION

Post-surgical infection (PSI) is a soft-tissue infection that occurs around the wound site (1). The high risk of infection may occur in post-traumatic fractures compared to non-traumatic ones after surgery (2, 3). PSI may be associated with trauma related to soft-tissue damage, contamination, systemic diseases, blood supply status, and other factors (3). Incidence of infection after ankle fractures is 1%-8% (4). Risk factors for PSI are history of previous surgery, infection, history of radiotherapy, age, high ASA score, obesity, diabetes, smoking, and inappropriate wound care (5, 6). Diabetes mellitus (DM) is a systemic disease associated with blood glucose metabolism and prepares the ground for additional systemic problems (6). It is one of the important risk factors of wound infection after orthopedic surgery (6). In patients with DM, the rate of PSI is 10%-60%, the rate of amputation after open ankle fracture is 42%, and the rate of mortality is 11% (7, 8). TEC is a glycopeptide derivative antibiotic that acts as a bactericidal effect through the cell wall (8). In in vitro and clinical studies, TEC have been shown to be effective on osteomyelitis and on severe systemic infections associated with gram-positive bacteria such as corynebacterium and methicillin-resistant staphylococcus aureus (MRSA) (9). The aim of our study was to retrospectively evaluate the effect of local single-dose TEC on postoperative complications and functional outcomes in diabetic patients undergoing surgery due to tibial plafond fractures.

Figure 1. Anterior-posterior and lateral radiograph of the ankle before and after surgery

METHODS

After Local Ethics Committee Approval and patient inform consent were obtained; the hospital records of 154 patients who underwent open reduction and osteosynthesis with plate-screw fixation due to tibial plafond fractures between January 2007 and January 2016 were analyzed. The study was conducted in accordance with the principles of the Helsinki Declaration. The minimum follow-up period was 12 months. Patients with a previous history of ankle fracture, polytrauma, pathological fracture or Charcot neuropathy, and neurological and rheumatic comorbid diseases were excluded from the study. In the perioperative evaluation of 154 patients, there were 26 (16.8%) patients with DM using oral antidiabetic, insulin, or both. Four of the 26 cases (15.3%) were excluded from the study because their regular follow-up records were unavailable. The remaining 22 patients (84.7%) were divided into two groups based on local TEC administration. Before the surgery, a single 2-g dose of cefazolin (IV) was routinely administered as a prophylaxis in Group T (n=12) and Group C (the group in which local TEC was not administered, n=10). Cefazolin 1-g (BID) was administered postoperatively for 24 h. In patients with penicillin allergy, clindamycin was used instead of cefazolin. Antidiabetic drugs were discontinued on the day of surgery in all diabetic patients. In addition, subcutaneous intermittent insulin administration was performed according to perioperative insulin scale, and the blood glucose level was maintained <200 mg/dL (6). Tibial plafond fractures were classified according to

Figure 2. a-c. Open reduction plate–screw fixation of the ankle (a), administration of local teicoplanin (b) and postoperative early clinical photographs after surgery (c)

AO/Orthopedic Trauma Association (OTA) classification. AO/OTA 43B and 43C fractures were included in the study. Through anteromedial approach, open reduction and osteosynthesis with plate-screw fixation were applied in all patients (Figure 1). After osteosynthesis, 400 mg of local TEC was administered in the surrounding region of the plate–screw in Group T (Figure 2). After bleeding control in both groups, the layers were properly closed. Superficial wound separation and wound site necrosis were considered as mild soft-tissue complications. The lesions with positive wound culture results and treated with non-surgical modalities (oral antibiotherapy and dressing) were considered as superficial wound infection; on the other hand, osteomyelitis, removal of the implant due to the colonized implant, presence of fistula requiring debridement, and requirement for parenteral antibiotics were considered as deep wound infection (10).

In addition to the demographic data, Group T and Group K were evaluated in terms of ASA score, duration of operation (min), length of hospital stay (LOS, day), post-surgical superficial or deep wound infection, reoperation rate, and amputation rate.

Statistical Analysis

The Statistical Package for Social Sciences, version 22.0 (IBM SPSS Corp.; Armonk, NY, USA) program was used for statistical analysis. The data were analyzed with descriptive statistical methods (mean, standard deviation). The distribution of the data was analyzed using the Kolmogorov-Smirnov test. Independent samples t test was used for parametric values. The nonparametric data were analyzed with chi-square test. A p value of <0.05 was considered statistically significant.

RESULTS

The mean age was 59.91±7.82 years in Group T and 62.40±8.30 in Group C; there was no significant difference between both groups (p=0.479) (Table 1). Of the patients, 59.1% (n=13) were female and 40.9% (n=9) were male; the right side was affected in 54.5% (n=12) and left side in 45.5% patients (n=10). Of the patients who underwent surgery according to the AO/OTA classification, 63.6% patients (n=14) had type 3B, and 36.4% patients (n=8) had type 3C fractures. There was no statistically significant difference between the mean ASA scores of the patients (Group T: 2.00±0.95, Group C: 1.90±0.99; p=0.813). The mean duration of operation was 78.66±14.29 min in Group T and 79.90±17.41 min in Group C. There was no significant difference between these two groups in terms of this parameter (p=0.857). One superficial wound site problem was detected in both groups and they were cleared up with excessive dressing every other day. PSI was detected in a total of seven patients (31.8%): one superficial and one deep in Group T and one superficial and four deep in Group C. There was no significant difference in terms of superficial wound infection in both groups (Group C vs Group T, 10% vs 8.8%; p=0.895). Deep wound infection was significantly higher in Group C than in Group T (40% vs 8.3%, p=0.035). In the second-year follow-up, the reoperation rate in Group C was significantly higher than that in Group T (1.5±1.7 vs 0.16±0.57, p=0.02). The LOS was also significantly longer in Group C than in Group T (22.60±18.02 vs. 9.08±8.36, p=0.03). While no amputation was performed in any of the patients in Group T at the end of postoperative 2 years, it is noteworthy that transtibial amputation was performed in two patients in Group C (16.6%) due to chronic osteomyelitis. No cases of erythema, anaphylaxis, or local reaction due to local TEC administration were detected in any patient in Group T.

Table 1. Comparison of age, ASA, DO, reoperation rates, and LOS parameters of both groups

	Group T (Mean±SD)	Group K (Mean±SD)	p
Age	59.91±7.82	62.40±8.30	0.479
ASA	2.00±0.95	1.90±0.99	0.813
Duration of operation (Minutes)	78.66 ±14.29	79.90±17.41	0.857
Number of Reoperations	0.16±0.57	1.5±1.7	0.02
LOS (days)	9.08±8.36	22.60±18.02	0.03

ASA: american society of anesthesiologists; LOS: length of hospital stay; DO: duration of operation; Avg: average; SD: standard deviation

DISCUSSION

The most important finding of this study was that 400 mg local TEC administration decreased the rate of post-surgical deep infection in patients who underwent open surgery for tibial plafond fracture. When the literature was evaluated, a few studies related to local TEC administration in the wound site in diabetic patients were found. For example, Lalla et al. (11) reported that they administered local TEC in total knee arthroplasty patients without performing systemic prophylaxis after tourniquet, and there were no systemic and local complications. They also indicated that the infection rate was similar to that in knee prostheses in which systemic prophylaxis was applied, and this application could be safe and effective in comparison to traditional methods. This may be due to the fact that locally administered TEC reduces the perioperative contamination of the bacteria, which may form a biofilm layer and cause deep implant infection. Advanced microbiological studies are needed to clarify this issue. Fracture treatment in diabetes is considered to be an important and independent risk factor for wound infection in many orthopedic procedures such as spinal surgery (12, 13). For example, Kline et al. (12) evaluated cases treated for tibial plafond fracture in their 2009 retrospective study, and they reported the rate of PSI as 71%, 43% of which were deep and 28% were superficial in the diabetic group; in the non-diabetic group, the rate of PSI was 19%, 9% of which was deep and 10% was superficial. Flynn et al. (14) also reported that the rate of infection was twice as high in diabetic patients who had undergone surgery after a closed ankle fracture than those who had not. Wukich et al. (15) found that the rate of infection in diabetic patients was four times higher in their study in terms of PSI and risk factors with 1000 patients who had undergone ankle surgery. In our study, a high rate of superficial wound site problem and postoperative infection was detected in diabetic plafond fracture surgery in accordance with the literature. Systemic complications such as diabetes-induced neuropathy, vasculopathy, and immune dysfunction may lead to trauma and the development of infection mechanisms. PSI constitutes 20% of all nosocomial infections in orthopedics (16). It has been reported in the literature that PSI prolongs hospital stay by 12-20 days, increases the reoperation rate twofold, and leads to a threefold increase in hospital costs (3-17). It also has negative effects on the quality of life and physical activity level (17). In this study, PSI, LOS, and reoperation rates in Group T were found significantly lower than those in Group C. Although uncertain, the mechanism of local TEC treatment seems to be effective on reoperation rate and LOS by decreasing the rate of deep wound infection. TEC is a broad-spectrum antibiotic that can achieve high concentrations in all soft tissues except for cerebrospinal fluid, which has a long serum half-life against gram-positive aerobic and anaerobic organisms (18). It is the most commonly used antibiotic in Europe for the treatment of osteomyelitis because it has less ototoxicity, nephrotoxicity, and fewer gastrointestinal side effects compared with vancomycin (19, 20). It is reported that 65% of the serum concentration of TEC can be reached in bone within the 30th minute after IV administration (21). In their study of animal model with MRSA osteomyelitis, Jia et al. (20) compared a group treat-

ed with calcium sulfate biomaterial and borate supplemented with TEC with a group treated only with IV TEC, and they reported that TEC release continued in the TEC + biomaterial group for 4 weeks, and the radiological, histological, and culture results were better. In accordance with the literature, we determined that perioperative local TEC administration could decrease the rate of deep wound infection and amputation requirement. Pilon fractures are fractures extending to the ankle joint in the tibia metaphysis, accounting for 1%-5% of all lower extremity fractures. It is a high-energy injury and is usually accompanied by soft-tissue injury. The anatomic restoration of the joint is often achieved by open reduction plate–screw fixation. Difficult surgical process and severe soft-tissue and bone injury prepare the ground for wound infection. It is reported that PSI can be seen in 9%-55% after the tibial plafond fracture (22, 23). In our study, the rate of PSI was found to be 27.3% in accordance with the literature. The use of a single-center, retrospective nature of the study with less number of patients, lack of long-term follow-up results, lack of all microbiological culture results, and lack of functional evaluation of the extremity are the limitations of our study.

CONCLUSION

Perioperative local TEC treatment has positive effects on deep wound infection, reoperation rates, and LOS in diabetic patients who undergo open reduction and plate fixation due to tibial plafond fracture.

Ethics Committee Approval: Ethics committee approval was received for this study from the local ethics committee of Okmeydanı Research Hospital (Decision Date: 2017/Decision No: 623).

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The author has no conflicts of interest to declare.

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REFERENCES

1. Wukich DK, Lowery NJ, McMillen RL, Frykberg RG. Postoperative infection rates in foot and ankle surgery: a comparison of patients with and without diabetes mellitus. J Bone Joint Surg Am 2010; 92: 287-95. [CrossRef]
2. Thu LT, Dibley MJ, Ewald B, Tien NP, Lam LD. Incidence of surgical site infections and accompanying risk factors in Vietnamese orthopaedic patients. J Hosp Infect 2005; 60: 360-7. [CrossRef]
3. Bachoura A, Guitton TG, Smith RM, Vrahas MS, Zurakowski D, Ring D. Infirmity and injury complexity are risk factors for surgical-site infection after operative fracture care. Clin Orthop Relat Res 2011; 469: 2621-30. [CrossRef]
4. National Nosocomial Infections Surveillance System. National Nosocomial Infections Surveillance (NNIS) System Report, data summary from January 1992 through June 2004, issued October 2004. Am J Infect Control 2004; 32: 470-85. [CrossRef]
5. Friedman ND, Sexton DJ, Connelly SM, Kaye KS. Risk factors for surgical site infection complicating laminectomy. Infect Control Hosp Epidemiol 2007; 28: 1060-5. [CrossRef]
6. Hikata T, Iwanami A, Hosogane N, Watanabe K, Ishii K, Nakamura M, et al. High preoperative hemoglobin A1c is a risk factor for surgical site infection after posterior thoracic and lumbar spinal instrumentation surgery. J Orthop Sci 2014; 19: 223-8. [CrossRef]
7. Costigan W, Thordarson DB, Debnath UK. Operative Management of Ankle Fractures in Patients with Diabetes Mellitus. Foot Ankle Int 2007; 28: 32-7. [CrossRef]
8. White CB, Turner NS, Lee GC, Haidukewych GJ. Open Ankle Fractures in Patients With Diabetes Mellitus. Clin Orthop Relat Res 2003; 414: 37-44. [CrossRef]
9. De Lada F, Santoro D, Rinaldi E, Suter F, Cruciani M, Guaglianone MH, et al. Teicoplanin in the treatment of infections by staphylococci, clostridium difficile and other gram-positive bacteria. J Antimicrob Chemother 1989; 23: 131-42. [CrossRef]
10. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control 1999; 27: 97-132. [CrossRef]
11. De Lalla F, Viola R, Pellizzer G, Lazzarini L, Tramarin A, Fabris P. Regional prophylaxis with teicoplanin in monolateral or bilateral total knee replacement: An open study. Antimicrob Agents Chemother 2000; 44: 316-9. [CrossRef]
12. Kline AJ, Gruen GS, Pape HC, Tarkin IS, Irrgang JJ, Wukich DK. Early Complications Following the Operative Treatment of Pilon Fractures with and without Diabetes. Foot Ankle Int 2009; 30: 1042-7. [CrossRef]
13. Chen S, Anderson MV, Cheng WK, Wongworawat MD. Diabetes Associated with Increased Surgical Site Infections in Spinal Arthrodesis. Clin Orthop Relat Res 2009; 467: 1670-3. [CrossRef]
14. Flynn JM, Rodriguez-Del-Río F, Pizá PA. Closed ankle fractures in the diabetic patient. Foot Ankle Int 2000; 21: 311-9. [CrossRef]
15. Wukich DK, Joseph A, Ryan M, Ramirez C, Irrgang JJ. Outcomes of Ankle Fractures in Patients with Uncomplicated versus Complicated Diabetes. Foot Ankle Int 2011; 32: DOI: 10.3113/FAI.2011.0120 [CrossRef]
16. Saadatian-Elahi M, Teyssou R, Vanhems P. Staphylococcus aureus, the major pathogen in orthopaedic and cardiac surgical site infections: A literature review. Int J Surg 2008; 6: 238-45. [CrossRef]
17. Whitehouse JD, Friedman ND, Kirkland KB, Richardson WJ, Sexton DJ. The Impact of Surgical-Site Infections Following Orthopedic Surgery at a Community Hospital and a University Hospital Adverse Quality of Life, Excess Length of Stay, and Extra Cost. Infect Control Hosp Epidemiol 2002; 23: 183-9. [CrossRef]
18. Brogden RN, Peters DH. Teicoplanin. A reappraisal of its antimicrobial activity, pharmacokinetic properties and therapeutic efficacy. Drugs 1994; 48: 929. [CrossRef]
19. Svetitsky S, Leibovici L, Paul M. Comparative efficacy and safety of vancomycin versus teicoplanin: Systematic review and meta-analysis. Antimicrob Agents Chemother 2009; 53: 4069-79. [CrossRef]
20. Jia WT, Fu Q, Huang WH, Zhang CQ, Rahaman MN. Comparison of borate bioactive glass and calcium sulfate as implants for the local delivery of teicoplanin in the treatment of methicillin-resistant Staphylococcus aureus-induced osteomyelitis in a rabbit model. Antimicrob Agents Chemother 2015; DOI: 10.1128/AAC.00196-15. [CrossRef]
21. Rowland, M. Clinical pharmacokinetics of teicoplanin. Clin Pharmacokinet 1990; 184-209. [CrossRef]
22. Dillin L, Slabaugh P. Delayed wound healing, infection, and nonunion following open reduction and internal fixation of tibial plafond fractures. J Trauma - Inj Infect Crit Care 1986; 26: 1116-9. [CrossRef]
23. Chen SH, Wu PH, Lee YS. Long-term results of pilon fractures. Arch Orthop Trauma Surg 2007; 127: 55-60. [CrossRef]