

The effect of antibiotic prophylaxis on treatment success in hemodialysis patients during dental treatment: A systematic review

Abstract

Dental treatments, including soft and hard tissues, can transfer bacteria to blood serum and cause infective endocarditis in susceptible and at-risk patients. Therefore, antibiotic prophylaxis is required in these cases. The purpose of this study was to investigate the need for antibiotic prophylaxis in hemodialysis patients undergoing dental treatment. Articles from the desired databases using the keywords "antibiotic prophylaxis" and "hemodialysis" and search in English language databases, Medline (Ovid), CINHAL, The Cochrane Library, Scopus, ProQuest, and Persian language Such as SID, IranDoc, Magiran IranMedex was performed. Out of 18 selected studies from 120 articles that examined antibiotic prophylaxis in patients undergoing hemodialysis during dental treatment, most articles (16 articles) showed that patients with renal failure (kidney dialysis) are better treated with antibiotic prophylaxis and the infection doesn't relapse. Few articles (2 articles) referred to the limited and cautious use of antibiotic prophylaxis. Antibiotic prophylaxis seems to be necessary for patients who need to undergo dental surgery. In these patients, the risk of infection increases due to increased systemic disease and leukocyte dysfunction. Therefore, these people are also suitable for antibiotic use and antibiotic prophylaxis.

Keywords: *Prophylaxis, Antibiotic, Hemodialysis, Dentistry*

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Introduction

Prophylaxis is the prevention of disease and the purpose of prescribing prophylactic antibiotics is to prevent the occurrence and occurrence of infection or to prevent the development or spread of infection during dental treatment of some patients with a particular medical condition. The use of antibiotics to prevent wound infections after surgery can be very effective in certain conditions. (1, 2). In dentistry, antibiotics are used to treat patients with immune system problems, obvious signs of systemic infection, and signs and symptoms of infection that are rapidly progressing (3). Patients with chronic kidney failure (CKF) who have undergone dialysis or a kidney transplant are susceptible to a variety of infections. Asymptomatic bacteria are found in many dental surgeries, especially those involving mucous membranes. Some bacteria may cause serious complications in these patients (4). Therefore, antibiotic prophylaxis is essential in cases where these patients undergo dental surgery.

Penicillin is highly susceptible to gram-positive and anaerobic bacteria and detects organisms in alveolar abscess, periodontal abscess, and necrotic pulp, so it is considered the drug of choice in the treatment of odontogenic infections. However, physicians and researchers are still concerned about the overuse of antibiotics and the resistance of microorganisms. In these patients, the risk of infection increases due to increased systemic disease and leukocyte dysfunction. Therefore, these people are also suitable for antibiotic use and antibiotic prophylaxis. As kidney injury progresses, clinical manifestations are seen in almost all organs and systems of the body, and 90% of patients experience oral symptoms. Clinical

symptoms occur in almost every organ or system of the body, and oral symptoms occur in 90% of patients. Simple measures have been proposed to manage these symptoms, from diet and lifestyle changes to various forms of dialysis (hemodialysis and peritoneal dialysis) and kidney transplants. Patients with chronic kidney failure have many oral symptoms and the various consequences of its treatment on the oral cavity, so these patients require special care during the treatment. It is essential to consult a nephrologist before dental treatment to determine the patient's condition, determine the best time for dental treatment and avoid dental treatment complications. ESRD or hemodialysis is not a standard for IE prophylaxis. According to the guidelines of the American Heart Association, antibiotics are recommended for patients suffering from patients with concomitant heart disease such as artificial heart valves, previous IE, and non-reconstructed congenital cyanotic heart disease (CHD), congenital heart defect completely reconstructed with prosthetic material or device. In the first six months after surgery, CHD was reconstructed with a defect remaining at or near the site of the artificial adhesive or prosthesis, and heart transplant recipients with damaged heart valves (8). However, patients with ESRD are more sensitive to IE, especially when they can't control their diseases well. In addition, patients on hemodialysis may suffer from infections due to vascular access (endarteritis) which can become a source of bacteremia, and therefore antibiotic prophylaxis is appropriate for these individuals (10). According to ongoing disagreements, the best way to discuss with a patient nephrologist for case-by-case evaluation and indication is antibiotic prophylaxis (6-10). According to a

study by Chamani et al., Patients with chronic kidney failure appear to have less periodontal health than normal patients. The present study showed that oral care practices at home are inadequate. (11) Therefore, preventive and therapeutic programs are needed to improve oral health in hemodialysis patients. One such treatment program is antibiotic prophylaxis. However, this study showed that antibiotic prophylaxis is recommended in only a small percentage of patients at risk for severe infectious complications (including infective endocarditis and artificial joint infection, Septicemia in patients with severe immunodeficiency, and Osteonecrosis of the Jaw associated with bisphosphonates. This study aimed to evaluate the need for antibiotic prophylaxis in hemodialysis patients during dental treatment, which is performed for the first time, so there are no systematic findings on the effect of antibiotic prophylaxis in hemodialysis patients.

Procedure

The present study was systematic. The search was conducted in English language databases, Medline (Ovid), CINHAL, The Cochrane Library, Scopus, ProQuest, and Persian language, SID, IranDoc, Magiran IranMedex. The article was selected after being extracted from the specified database. The articles were selected by the subject expert in 3 steps after extraction from the desired databases. In these databases PICO stands for p: Dialysis patients I: Keywords related to therapeutic intervention, exposure, or diagnostic methods such as antibiotic prevention by penicillin, C: Keywords related to comparisons such as antibiotic prophylaxis with other treatments in hemodialysis and non-hemodialysis patients and O: Keywords associated with favorable outcomes such as dental treatment success and infection. First, the titles of all articles were reviewed and those that contradict the purpose of the study were excluded. In the next steps, the abstract and the full text of the articles were studied, respectively, to identify and exclude studies that include exclusion criteria and have a weak communication with the objectives of the study.

Inclusion criteria

- * A randomized controlled clinical trial
- * Case-control studies
- * Articles published in Persian and English
- * Published studies from 1990 to February 2021
- * Papers presented at conferences

Exclusion criteria

All studies published in English and Persian were included in the study, and other languages were excluded from the study.

- Research on animals was conducted
- Studies related before 1990 were excluded from the study
- Articles that are not of the required quality
- Reprint articles that use the same sample information
- letters to the editor or suggestions

The studies selected by the two experts were then evaluated using the Checklist (JADAD) for the risk of bias, and the differences between the two experts were referred to a third party.

After the final selection of the survey, the required information was extracted and summarized using a table (extraction table) designed in the Excel software environment. Endnote X7 resource management software was also used to sort out, investigate, and identify duplicate titles and summaries. The results of each study were reported separately because a meta-analysis could not be performed (for example, due to the heterogeneity of studies, etc.) The results of the studies were reported individually because a meta-analysis was not possible due to one of the above reasons and a few studies.

Findings

In the initial search, 400 articles were obtained and 120 articles were excluded due to duplication, obsolescence, and lack of references to all keywords. Many other articles simply emphasized the need for health care in people with a variety of kidney disorders. Finally, 18 articles were included in the study based on inclusion and exclusion criteria, the characteristics and results of which are shown in Tables 1.

Table (1): Survey of study characteristics

researcher	Year	Study result	References
Scott et al., 1996 (1)	1996	Another study by Scott et al. showed that the hematological condition that most patients with kidney disease suffer from is excessive bleeding and consequent anemia. Bleeding gums, wounds, petechiae, and ecchymosis are the most commonly reported problems in these patients and are usually seen orally. According to the above cases, taking medications for these patients should be done with caution. The risk of infection is also high in patients	Scott s., De Rossi, M. Glick., Dental considerations for the patient with renal disease receiving hemodialysis, 1996 The Journal of the American Dental Association, 127, 2, 211-219,

with kidney failure, and when these patients have oral problems, the risk of death from bacterial infections significantly increases. Therefore, the use of antibiotics when treating oral problems is mandatory in this group of patients.

- Werner et al., 1999
1999(2)** Bacterial endocarditis BE is an uncommon but potentially serious event in dentistry. Hemodialysis patients should be classified as "moderate risk of BE" according to AHA guidelines. As stated in these instructions, prophylactic antibiotics should be prescribed to these patients before dental treatment. Werner CW, Saad TF. Prophylactic antibiotic therapy before dental treatment for patients with end-stage renal disease. *Spec Care Dentist*. 1999 May-Jun; 19(3):106-11. DOI: 10.1111/j.1754-4505.1999.tb01409.x. PMID: 10860073.
- Lockhart et al., 2002
2002(3)** According to published medical sources and guidelines, patients with various medical conditions undergoing invasive dental treatment often use antimicrobial or antibiotic prophylaxis to prevent a variety of disorders, including kidney problems (catheter insertion or shunt for kidney dialysis). Lockhart, P. B., Michael T. Brennan, Philip C. Fox, H. James Norton, Daniel B. Jernigan, Larry J. Strausbaugh, Infectious Diseases Society of America Emerging Infections Network, Decision-Making on the Use of Antimicrobial Prophylaxis for Dental Procedures: A Survey of Infectious Disease Consultants and Review, *Clinical Infectious Diseases*, Volume 34, Issue 12, 15 June 2002, Pages 1621–16
- Tong et al., 2004
2004(4)** This study shows that if patients are allergic to penicillin, most physicians follow the guidelines of the American Heart Association (AHA) with oral administration of 2 grams of amoxicillin or 600 mg of clindamycin. Examining the sources and data of the questionnaire reveals that kidney disease patients undergoing hemodialysis in Australia and New Zealand are protected by antibiotics before invasive dental treatment. The standard dose is 2 mg oral amoxicillin or 600 mg oral clindamycin 1 hour before surgery, as recommended by AHA. Peritoneal dialysis patients are usually not given prophylactic doses of antibiotics. Tong DC, Walker RJ. Antibiotic prophylaxis in dialysis patients undergoing invasive dental treatment. *Nephrology (Carlton)*. 2004 Jun; 9(3):167-70. DOI: 10.1111/j.1440-1797.2004.00245.x. PMID: 15189178.

Chen et al.,2006(5)	2006	Chen et al. Showed that patients with kidney failure (kidney dialysis) are in better condition with antibiotic prophylaxis.	Chen, Li-Ping., Chih-Kang Chiang, Chiu-Po Chan, Kuan-Yu Hung, Chiung-Shing Huang, Does Periodontitis Reflect Inflammation and Malnutrition Status in Hemodialysis Patients? American Journal of Kidney Diseases,2006 American Journal of Kidney Diseases, 47, 5, 815-822.
Lockhart, and Loven, 2007(6)	2007	This study points to the lack of scientific evidence for prescribing antibiotic prophylaxis to prevent infective endocarditis (IE) in ESRD patients [7, 6]. ESRD or hemodialysis is not a standard for IE prophylaxis.	Lockhart, P. B., B. Loven, M. T. Brennan, and P. C. Fox, "The evidence base for the efficacy of antibiotic prophylaxis in dental practice," <i>Journal of the American Dental Association</i> , vol. 138, no. 4, pp. 458-474, 2007.
Klassen and Krasko, 2002(7)	2002	According to the guidelines of the American Heart Association, antibiotics are recommended for patients suffering from patients with concomitant heart disease such as artificial heart valves, previous IE, and non-reconstructed congenital cyanotic heart disease (CHD), congenital heart defect completely reconstructed with prosthetic material or device. In the first six months after surgery, CHD was reconstructed with a defect remaining at or near the site of the artificial adhesive or prosthesis, and heart transplant recipients with damaged heart valves (8). However, patients with ESRD are more sensitive to IE, especially when they can't control their diseases well [9]. Patients on hemodialysis may suffer from infections due to vascular access (endarteritis) which can become a source of bacteremia, and therefore antibiotic prophylaxis is appropriate for these individuals (10). According to ongoing disagreements, the best way to discuss with a patient nephrologist for case-by-case evaluation and indication is antibiotic prophylaxis (6-10).	T. Klassen and B. M. Krasko, "The dental health status of dialysis patients," <i>Journal of the Canadian Dental Association</i> , vol. 68, pp. 34-38, 2002
Wilson et al.,2007(8)	2006		W. Wilson, K. A. Taubert, M. Gewitz, et al., "Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working
Gutiérrez et al.,2006(9)	2010		
Venkatesan et al., 2010(10)			

Group,” *Circulation*, vol. 116, no. 15, pp. 1736–1754, 2007, In press.

J. L. Gutiérrez, J. V. Bagán, A. Bascones et al., “Consensus document on the use of antibiotic prophylaxis in dental surgery and procedures,” *Medicina Oral Patología Oral y Cirugía Bucal*, vol. 11, pp. E188–205, 2006.

A. M. Venkatesan, S. Kundu, D. Sacks, Society of Interventional Radiology Standards of Practice Committee et al., “Practice guidelines for adult antibiotic prophylaxis during vascular and interventional radiology procedures. Written by the Standards of Practice Committee for the Society of Interventional Radiology and Endorsed by the Cardiovascular Interventional Radiological Society of Europe and Canadian Interventional Radiology Association [corrected],” *Journal of Vascular and Interventional Radiology*, vol. 21, no. 11, pp. 1611–1630, 2010.

Cerveró, et al. 2008 2008(11)	In this study, the necessary measures for patients with chronic renal failure are shown as follows: Dental care on non-dialysis days, receiving CBC before invasive treatment, and considering antibiotic prophylaxis for these patients	Cerveró, A. Jover, et al. "Dental management in renal failure: patients on dialysis." <i>Med Oral Patol Oral Cir Bucal</i> 13.7 (2008): E419-26.
Chamani et al., 2009 2009(12)	According to a study by Chamani et al., Patients with chronic kidney failure appear to have less periodontal health than normal patients. The present study showed that oral care practices at home are inadequate. (11) Therefore, preventive and therapeutic programs are	Chamani G, Zarei MR, Radvar M, Rashidfarrokhi F, Razazpour F. Oral health status of dialysis patients based on their renal dialysis

		needed to improve oral health in hemodialysis patients. One such treatment program is antibiotic prophylaxis.	history in Kerman, Iran. <i>Oral Health Prev Dent</i> . 2009;7(3):269-75. PMID: 19780434.
Termine et al., 2009 2009(13)	2009	However, this study showed that antibiotic prophylaxis is recommended in only a small percentage of patients at risk for severe infectious complications (including infective endocarditis and artificial joint infection, Septicemia in patients with severe immunodeficiency, and Osteonecrosis of the Jaw associated with bisphosphonates.	Termine, N., Panzarella, V., Ciavarella, D., Lo Muzio, L., D'Angelo, M., Sardella, A., Compilato, D. & Campisi, G. (2009) Antibiotic prophylaxis in dentistry and oral surgery: Use and misuse. <i>International Dental Journal</i> 59: 263–270.
Venkatesan et al., 2010 2010(14)	2010	Patients undergoing hemodialysis can develop vascular infections that can become a source of bacteremia. Therefore, they seem to be able to benefit from the positive effects of antibiotic prophylaxis.	A. M. Venkatesan, S. Kundu, D. Sacks, Society of Interventional Radiology Standards of Practice Committee et al., "Practice guidelines for adult antibiotic prophylaxis during vascular and interventional radiology procedures. Written by the Standards of Practice Committee for the Society of Interventional Radiology and Endorsed by the Cardiovascular Interventional Radiological Society of Europe and Canadian Interventional Radiology Association [corrected]," <i>Journal of Vascular and Interventional Radiology</i> , vol. 21, no. 11, pp. 1611–1630, 2010.
Vasanthan and Dallal, 2007 2007(15)	2007	In patients on hemodialysis, if there is an acute infection or exacerbation of dental problems (periapical periodontitis, periapical or periodontal abscess), a full course of antibiotic therapy using non-nephrotoxic antibiotics should be performed. Penicillin and its derivatives, clindamycin, and cephalosporins are safer antibiotics for these patients.	A. Vasanthan and N. Dallal, "Periodontal treatment considerations for cell transplant and organ transplant patients," <i>Periodontol</i> 2000, vol. 44, pp. 82–102, 2007.
Martí Alamo et al., 2011 2011(16)	2011		S. Martí Alamo, C. Gavaldá Esteve, and M. G. Sarrión Pérez, "Dental considerations for the

patient with renal disease,” *Journal of Clinical and Experimental Dentistry*, vol. 3, pp. E112–E119, 2011.

Tiwari et al. 2013 (2013). (17)	This study provides evidence of periodontal problems in patients with kidney disease more often than in healthy individuals, highlighting the need for antibiotic prevention. In this study, it was also found that the number of patients with periodontal disease (bleeding and mass) among patients with kidney disease was significantly higher compared to the control group ($p < 0.05$), and also the average prevalence of caries among Cases were significantly higher than the control group ($p < 0.05$)	Tiwari V., Saxena V., Bhambhal A., et al. (2013). The oral health status of patients with renal disease in central India: a preliminary study. <i>Journal of Renal Care</i> 39, 208–213.
Reyes et al., 2016 (2016 (18)	This study shows that kidney patients should be treated with all issues related to kidney dysfunction and should be in a careful follow-up program until transplantation. Considering the potential for deterioration of the patient's general condition during and after dental treatment, it is important to consult a nephrologist. Early detection of oral lesions and strong precautions can minimize the need for comprehensive dental treatment.	U. Reyes, A. E. Spolarich, and P. P. Han, “A Comprehensive oral preventive care protocol for caring for the renal transplant population,” <i>Journal of Dental Hygiene</i> , vol. 90, pp. 88–99, 2016.
Constantinides et al., 2018(19)	The sources of this study suggest that kidney patients should be treated with all issues related to kidney dysfunction and should be in a careful follow-up program until transplantation. Early detection of oral lesions and strong precautions can minimize the need for comprehensive dental treatment. Also, in these patients, in case of acute infection or tooth recurrence, a full course of antibiotic therapy with non-nephrotoxic antibiotics should be performed.	Constantinides, F.; Castronovo, G.; Vettori, E.; Frattini, C.; Artero, M.L.; Bevilacqua, L.; Berton, F.; Nicolin, V.; Di Lenarda, R. Dental care for patients with end-stage renal disease and undergoing hemodialysis. <i>Int. J. Dent.</i> 2018, 9610892

Discussion.

Out of 18 selected studies from 120 articles that examined antibiotic prophylaxis in patients undergoing hemodialysis during dental treatment, most articles (16articles) showed that patients with renal failure (kidney dialysis) are better treated with antibiotic prophylaxis and the infection doesn't relapse. Few articles (2 articles) referred to the limited and cautious use of antibiotic prophylaxis. According to published medical sources and guidelines, patients with various medical conditions undergoing invasive dental treatment often use antimicrobial or antibiotic prophylaxis to prevent a variety of disorders, including kidney problems (catheter insertion or shunt for kidney dialysis).

A study by Werner et al. Showed that bacterial endocarditis BE is an uncommon but potentially serious event in dentistry. Hemodialysis patients should be classified as "moderate risk of BE" according to AHA guidelines. As stated in these instructions, prophylactic antibiotics should be prescribed to these patients before dental treatment [2]. Another study by Scott et al. showed that the hematological condition that most patients with kidney disease suffer from is excessive bleeding and consequent anemia. Bleeding gums, wounds, petechiae, and ecchymosis are the most commonly reported problems in these patients and are usually seen orally. According to the above cases, taking medications for these patients should be done with caution. The risk of infection is also high in patients with kidney failure, and when these patients have oral

problems, the risk of death from bacterial infections significantly increases. Therefore, the use of antibiotics when treating oral problems is mandatory in this group of patients [1]. The results of another study show that if patients are allergic to penicillin, most physicians follow the guidelines of the American Heart Association (AHA) with oral administration of 2 grams of amoxicillin or 600 mg of clindamycin. Examining the sources and data of the questionnaire reveals that kidney disease patients undergoing hemodialysis in Australia and New Zealand are protected by antibiotics before invasive dental treatment. The standard dose is 2 mg oral amoxicillin or 600 mg oral clindamycin 1 hour before surgery, as recommended by AHA. Peritoneal dialysis patients are usually not given prophylactic doses of antibiotics [4]. Chen et al. Showed that patients with kidney failure (kidney dialysis) are in better condition with antibiotic prophylaxis. This study points to the lack of scientific evidence for prescribing antibiotic prophylaxis to prevent infective endocarditis (IE) in ESRD patients [7, 6]. The sources of this study suggest that kidney patients should be treated with all issues related to kidney dysfunction and should be in a careful follow-up program until transplantation. Early detection of oral lesions and strong precautions can minimize the need for comprehensive dental treatment. Also, in these patients, in case of acute infection or tooth recurrence, a full course of antibiotic therapy with non-nephrotoxic antibiotics should be performed.

Conclusion

However, antibiotic prophylaxis for kidney and dialysis patients requires highly controversial dental treatments, but what makes it useful is the concerns and consequences of infection in some of these patients. In addition to the lack of evidence of the effectiveness of this practice, identifying at-risk patients as well as applying the right methods of each dentist in prophylaxis increases this risk. A randomized, placebo-controlled clinical trial should be performed to make definitive decisions about which patients and which dental procedures are appropriate. However, in general, a systematic review of studies showing the effectiveness of antibiotic prophylaxis in hemodialysis patients has led to the success of dental treatments and reduced the risk of infection. Hence, antibiotic prophylaxis seems reasonable for this group of patients who have complex systemic problems and are exposed to infections caused by oral and dental procedures.

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Conflict of interest

None.

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Ethics Statement

All Permissions to conducting this research has been approved.

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