[6] Hardes J, von Eiff C, Streitbuerger A, Balke M, Budny T, Henrichs MP, et al. Reduction of periprosthetic infection with silver-coated megaprostheses in patients with bone sarcoma. J Surg Oncol. 2010;101:389–395. doi:10.1002/jso.21498.
[7] Jeys LM, Grimer RJ, Carter SR, Tillman RM. Periprosthetic infection in patients treated for an orthopaedic oncological condition. J Bone Joint Surg Am. 2005;87:842–849. doi:10.2106/JBJS.C.01222.
[8] Li X, Moretti VM, Ashana AO, Lackman RD. Perioperative infection rate in patients with osteosarcomas treated with resection and prosthetic reconstruction. Clin Orthop Relat Res. 2011;469:2889–2894. doi:10.1007/s11999-011-1877-z.
[9] Grimer RJ, Carter SR, Tillman RM, Sneath RS, Walker PS, Unwin PS, et al. Endoprosthetic replacement of the proximal tibia. J Bone Joint Surg Br. 1999;81:488–494.
[10] Myers GJC, Abudu AT, Carter SR, Tillman RM, Grimer RJ. Endoprosthetic replacement of the distal femur for bone tumours: long-term results. J Bone Joint Surg Br. 2007;89:521–526. doi:10.1302/0301-620X.89B4.18631.
[11] Myers GJC, Abudu AT, Carter SR, Tillman RM, Grimer RJ. The long-term results of endoprosthetic replacement of the proximal tibia for bone tumours. J Bone Joint Surg Br. 2007;89:1632–1637. doi:10.1302/0301-620X.89B12.19481.
[12] Roberts P, Chan D, Grimer RJ, Sneath RS, Scales JT. Prosthetic replacement of the distal femur for primary bone tumours. J Bone Joint Surg Br. 1991;73:762–769.
[13] Eckardt JJ, Eilber FR, Rosen G, Mirra JM, Dorey FJ, Ward WG, et al. Endoprosthetic replacement for stage IIB osteosarcoma. Clin Orthop Relat Res. 1991:202–213.
[14] Morris HG, Capanna R, Del Ben M, Campanacci D. Prosthetic reconstruction of the proximal femur after resection for bone tumors. J Arthroplasty. 1995;10:293–299.
[15] Ilyas I, Pant R, Kurar A, Moreau PG, Younge DA. Modular megaprosthesis for proximal femoral tumors. Int Orthop. 2002;26:170–173. doi:10.1007/s00264-002-0335-7.
[16] Sharma S, Turcotte RE, Isler MH, Wong C. Cemented rotating hinge endoprosthesis for limb salvage of distal femur tumors. Clin Orthop Relat Res. 2006;450:28–32. doi:10.1097/01.blo.0000229316.66501.fc.
[17] Sewell MD, Spiegelberg BGI, Hanna SA, Aston WJS, Bartlett W, Blunn GW, et al. Total femoral endoprosthetic replacement following excision of bone tumours. J Bone Joint Surg Br. 2009;91:1513–1520. doi:10.1302/0301-620X.91B11.21996.
[18] Shekkeris AS, Hanna SA, Sewell MD, Spiegelberg BGI, Aston WJS, Blunn GW, et al. Endoprosthetic reconstruction of the distal tibia and ankle joint after resection of primary bone tumours. J Bone Joint Surg Br. 2009;91:1378–1382. doi:10.1302/0301-620X.91B10.22643.
[19] Morii T, Yabe H, Morioka H, Beppu Y, Chuman H, Kawai A, et al. Postoperative deep infection in tumor endoprosthesis reconstruction around the knee. J Orthop Sci. 2010;15:331–339. doi:10.1007/s00776-010-1467-z.
[20] Hanna SA, Sewell MD, Aston WJS, Pollock RC, Skinner JA, Cannon SR, et al. Femoral diaphyseal endoprosthetic reconstruction after segmental resection of primary bone tumours. J Bone Joint Surg Br. 2010;92:867–874. doi:10.1302/0301-620X.92B6.23449.
[21] Bickels J, Wittig JC, Kollender Y, Henshaw RM, Kellar-Graney KL, Meller I, et al. Distal femur resection with endoprosthetic reconstruction: a long-term followup study. Clin Orthop Relat Res. 2002:225–235.
[22] Racano A, Pazionis T, Farrokhyar F, Deheshi B, Ghert M. High infection rate outcomes in long-bone tumor surgery with endoprosthetic reconstruction in adults: a systematic review. Clin Orthop Relat Res. 2013;471:2017–2027. doi:10.1007/s11999-013-2842-9.
[23] Aponte-Tinao LA, Ayerza MA, Muscolo DL, Farfalli GL. What are the risk factors and management options for infection after reconstruction with massive bone allografts? Clin Orthop Relat Res. 2016;474:669–673. doi:10.1007/s11999-015-4353-3.
[24] Ghert M, Deheshi B, Holt G, Randall RL, Ferguson P, Wunder J, et al. Prophylactic antibiotic regimens in tumour surgery (PARITY): protocol for a multicentre randomised controlled study. BMJ Open. 2012;2(6):pii: e002197. doi:10.1136/bmjopen-2012-002197.
[25] PARITY Investigators. Prophylactic antibiotic regimens in tumour surgery (PARITY): a pilot multicentre randomised controlled trial. Bone Joint Res. 2015;4:154–162. doi:10.1302/2046-3758.49.2000482.

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QUESTION 3: Should patients with an oncologic endoprosthesis in place receive antibiotic prophylaxis during dental procedures?

RECOMMENDATION: Not routinely. Evidence-based guidelines by dentists and orthopaedic surgeons state that antibiotic prophylaxis is rarely appropriate for patients with prosthetic joints.

LEVEL OF EVIDENCE: Consensus.

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

The American Dental Association (ADA) [1] and the American Academy of Orthopaedic Surgeons (AAOS) [2,3] have issued updated guidelines regarding the need for antibiotic prophylaxis. The guidelines do not specifically address the topic of patients with an oncologic endoprosthesis. The guidelines are based on four case-control studies [4–7] that found no association between dental procedures and PJI and no effectiveness for antibiotic prophylaxis.

The ADA recommended that, "in general, for patients with prosthetic joint implants, prophylactic antibiotics are not recommended to prevent prosthetic joint infection." Likewise, the AAOS recommended that "the practitioner might consider discontinuing the practice of routinely prescribing prophylactic antibiotics for patients with hip and knee prosthetic joint implants undergoing dental procedures." The AAOS recommendations were more conservative than the ADA recommendations. The AAOS conducted a study using a modified Delphi procedure in which 14 experts were given scenarios involving patients with prosthetic joints and voted whether antibiotic prophylaxis was appropriate. The panel concluded that prophylaxis may be warranted in the following situations: procedures involving manipulation of the gingival tissue or periapical region of teeth or perforation of the oral mucosa in patients who are severely immunocompromised and (1) have uncontrolled diabetes (glucose > 200 mg/dl, $HbA_1C > 8\%$), or (2) have controlled diabetes (glucose < 200 mg/dl, $HbA_1C < 8\%$) and have a history of periprosthetic joint infection (PJI) that required surgery or (3) do not have diabetes and have a history of PJI that required surgery and the initial joint replacement surgery was < 1 year ago.

The Dutch Orthopaedic and Dental Societies issued guidelines based on nine studies, all deemed to be very low quality. These guidelines advise that antibiotic prophylaxis should not be given to prevent PJI, regardless of the patient's immune status.

Given the absence of studies in patients with an oncologic endoprosthesis, it seems prudent to apply the more moderate AAOS guidelines to this patient population.

REFERENCES

[1] Sollecito TP, Abt E, Lockhart PB, Truelove E, Paumier TM, Tracy SL, et al. The use of prophylactic antibiotics prior to dental procedures in patients with prosthetic joints: Evidence-based clinical practice guideline for dental practitioners—a report of the American Dental Association Council on Scientific Affairs. J Am Dent Assoc. 2015;146:11-16.e8. doi:10.1016/j.adaj.2014.11.012.

[2] AAOS and ADA. Prevention of orthopaedic implant infection in patients undergoing dental procedures. Evidence-based guideline and evidence report. https://www.aaos.org/uploadedFiles/PreProduction/Quality/Guidelines_and_Reviews/PUDP_guideline.pdf 2012.

[3] AAOS and ADA. Appropriate use criteria for the management of patients with orthopaedic implants undergoing dental procedures. http://www.aaos.org/poiudpauc. 2016.

[4] Skaar DD, O'Connor H, Hodges JS, Michalowicz BS. Dental procedures and subsequent prosthetic joint infections: findings from the Medicare Current Beneficiary Survey. J Am Dent Assoc. 2011;142:1343–1351.

[5] Swan J, Dowsey M, Babazadeh S, Mandaleson A, Choong PFM. Significance of sentinel infective events in haematogenous prosthetic knee infections. ANZ J Surg. 2011;81:40–45. doi:10.1111/j.1445-2197.2010.05486.x.

[6] Berbari EF, Osmon DR, Carr A, Hanssen AD, Baddour LM, Greene D, et al. Dental procedures as risk factors for prosthetic hip or knee infection: a hospital-based prospective case-control study. Clin Infect Dis 2010;50:8–16. doi:10.1086/648676.

[7] Jacobson JJ, Millard HD, Plezia R, Blankenship JR. Dental treatment and late prosthetic joint infections. Oral Surg Oral Med Oral Pathol 1986;61:413–417.

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QUESTION 4: Should prophylactic antibiotics be started in patients with an oncologic endoprosthesis who develop neutropenia secondary to postoperative chemotherapy?

RECOMMENDATION: Not routinely. Evidence-based guidelines recommend limiting the routine use of prophylactic antibiotics to high-risk patients with chemotherapy-induced neutropenia.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

Guidelines published by the Infectious Diseases Society of America (IDSA) and the National Comprehensive Cancer Network (NCCN) recommend the use of fluoroquinolone prophylaxis during neutropenia in high-risk patients [1,2]. Risk stratification is based on a number of criteria, including malignancy type. According to IDSA guidelines, "Low-risk patients are those with neutropenia expected to resolve within 7 days and no active medical co-morbidity, as well as stable and adequate hepatic function and renal function. These low-risk features are most commonly found among patients with solid tumors" [1].

These recommendations are based on meta-analyses which included predominantly patients with hematological malignancy [3–5]. None of the articles included in the meta-analyses examined antibiotic prophylaxis in patients with primary bone malignancy or patients with an oncologic endoprosthesis. Furthermore, none of the articles specifically addressed cancer patients with foreign bodies. The largest and most comprehensive of the meta-analyses found that antibiotic prophylaxis reduces overall mortality versus placebo, with a number-needed-to-treat of 34 and low heterogeneity [4].

Two reasons limit the use of antibiotic prophylaxis in low-risk patients. First, concerns exist regarding the development of bacterial resistance and subsequent infection [2]. Although a meta-analysis found that fluoroquinolone prophylaxis leads to a non-significant increase in colonization with resistant bacteria with no difference in infections due to resistant bacteria, concerns remain [6]. Second, guidelines recommend treating low-risk patients with neutropenic fever as outpatients, with oral antibiotics including fluoroquinolones on an outpatient basis. It is unclear whether the potential benefit of prophylactic quinolone use is greater than that of the use of these agents as treatment [2,7]. In summary, given the evidence to date, patients with an oncologic endoprosthesis should not routinely receive antibiotic prophylaxis during neutropenic episodes.

REFERENCES

[1] Freifeld AG, Bow EJ, Sepkowitz KA, Boeckh MJ, Ito JI, Mullen CA, et al. Clinical practice guideline for the use of antimicrobial agents in neutropenic patients with cancer: 2010 update by the Infectious Diseases Society of America. Clin Infect Dis. 2011;52:e56-93. doi:10.1093/cid/cir073.

[2] National Comprehensive Cancer Network. NCCN clinical practice guidelines in oncology: prevention and treatment of cancer-related infections. Version 1. https://www.nccn.org/ 2017.

[3] Cruciani M, Rampazzo R, Malena M, Lazzarini L, Todeschini G, Messori A, et al. Prophylaxis with fluoroquinolones for bacterial infections in neutropenic patients: a meta-analysis. Clin Infect Dis. 1996;23:795–805.

[4] Gafter-Gvili A, Fraser A, Paul M, van de Wetering M, Kremer L, Leibovici L. Antibiotic prophylaxis for bacterial infections in afebrile neutropenic patients following chemotherapy. Cochrane Database Syst Rev. 2005:CD004386. doi:10.1002/14651858.CD004386.pub2.

[5] van de Wetering MD, de Witte MA, Kremer LCM, Offringa M, Scholten RJPM, Caron HN. Efficacy of oral prophylactic antibiotics in neutropenic afebrile oncology patients: a systematic review of randomised controlled trials. Eur J Cancer. 2005;41:1372–1382. doi:10.1016/j.ejca.2005.03.006.

[6] Gafter-Gvili A, Paul M, Fraser A, Leibovici L. Effect of quinolone prophylaxis in afebrile neutropenic patients on microbial resistance: systematic review and meta-analysis. J Antimicrob Chemother. 2007;59:5–22. doi:10.1093/jac/dkl425.

[7] Taplitz RA, Kennedy EB, Bow EJ, Crews J, Gleason C, Hawley DK, et al. Outpatient management of fever and neutropenia in adults treated for malignancy: American Society of Clinical Oncology and Infectious Diseases Society of America Clinical Practice Guideline Update. J Clin Oncol. 2018;36:1443–1453. doi:10.1200/JCO.2017.77.6211.