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QUESTION 3: Are there perioperative antibiotics that should be used for patients who have specific preoperative risk factors (e.g., patient sex and comorbidities) for shoulder periprosthetic joint infection (PJI)?

RECOMMENDATION: While risk of infection may be affected by demographics and comorbidities, outside of known methicillin-resistant *Staphylococcus aureus* (MRSA) colonization or true allergy, there are not patient-specific factors that justify a change in prophylaxis recommendations. Patients with MRSA colonization should receive a glycopeptide in addition to standard prophylaxis.

LEVEL OF EVIDENCE: Consensus

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

RATIONALE

The most common organisms to cause shoulder PJI are coagulase-negative staphylococcus species, *Cutibacterium acnes* and *Staphylococcus aureus* [1–7]. While the risk of shoulder PJI is impacted by comorbidities, and the prevalence of *Cutibacterium acnes* colonization is higher in men, there is no available data to support targeted modification of antimicrobial prophylaxis outside of the setting of known MRSA colonization. In the hip and knee arthroplasty setting, one study did not find that differential antimicrobial prophylaxis impacted surgical site infection risk when comorbidities were considered [8]. Studies have identified an increased risk of hip and knee PJI and surgical site infection when prophylaxis with an agent other than cefazolin is used [9,10].

REFERENCES

- [1] Grosso MJ, Frangiamore SJ, Yakubek G, Bauer TW, Iannotti JP, Ricchetti ET. Performance of implant sonication culture for the diagnosis of periprosthetic shoulder infection. *J Shoulder Elbow Surg.* 2018;27:211–216. doi:10.1016/j.jse.2017.08.008.
- [2] Richards J, Inacio MCS, Beckett M, Navarro RA, Singh A, Dillon MT, et al. Patient and procedure-specific risk factors for deep infection after primary shoulder arthroplasty. *Clin Orthop Relat Res.* 2014;472:2809–2815. doi:10.1007/s11999-014-3696-5.
- [3] Singh JA, Sperling JW, Schleck C, Harmsen W, Cofield RH. Periprosthetic infections after shoulder hemiarthroplasty. *J Shoulder Elbow Surg.* 2012;21:1304–1309. doi:10.1016/j.jse.2011.08.067.
- [4] Mook WR, Klement MR, Green CL, Hazen KC, Garrigues GE. The incidence of propionibacterium acnes in open shoulder surgery: a controlled diagnostic study. *J Bone Joint Surg Am.* 2015;97:957–963. doi:10.2106/JBJS.N.00784.
- [5] Falconer TM, Baba M, Kruse LM, Dorrestijn O, Donaldson MJ, Smith MM, et al. Contamination of the surgical field with *Propionibacterium acnes* in primary shoulder arthroplasty. *J Bone Joint Surg Am.* 2016;98:1722–1728. doi:10.2106/JBJS.15.01133.
- [6] Chuang MJ, Jancosko JJ, Mendoza V, Nottage WM. The incidence of *Propionibacterium acnes* in shoulder arthroscopy. *Arthroscopy.* 2015;31:1702–1707. doi:10.1016/j.arthro.2015.01.029.
- [7] Sethi PM, Sabetta JR, Stueck SJ, Horine SV, Vadasdi KB, Greene RT, et al. Presence of *Propionibacterium acnes* in primary shoulder arthroscopy: results of aspiration and tissue cultures. *J Shoulder Elbow Surg.* 2015;24:796–803. doi:10.1016/j.jse.2014.09.042.
- [8] Gupta K, Strymish J, Abi-Haidar Y, Williams SA, Itani KM. Preoperative nasal methicillin-resistant *Staphylococcus aureus* status, surgical prophylaxis, and risk-adjusted postoperative outcomes in veterans. *Infect Control Hosp Epidemiol.* 2011;32:791–796. doi:10.1086/660362.
- [9] Tan TL, Gomez MM, Kheir MM, Maltenfort MG, Chen AF. Should preoperative antibiotics be tailored according to patient's comorbidities and susceptibility to organisms? *J Arthroplasty.* 2017;32:1089–1094.e3. doi:10.1016/j.arth.2016.11.021.
- [10] Kheir MM, Tan TL, Azboy I, Tan DD, Parvizi J. Vancomycin prophylaxis for total joint arthroplasty: incorrectly dosed and has a higher rate of periprosthetic infection than cefazolin. *Clin Orthop Relat Res.* 2017;475:1767–1774. doi:10.1007/s11999-017-5302-0.

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QUESTION 4: What is the optimal duration of perioperative antibiotics following primary or revision shoulder arthroplasty?

RECOMMENDATION: For primary shoulder arthroplasty, prophylactic intravenous (IV) antibiotics should be given within one hour prior to incision to decrease the risk of infection. Intravenous antibiotics may be continued for 24 hours postoperatively. For revision shoulder arthroplasty, intravenous antibiotics should be given within one hour prior to incision. While controversial, the current evidence suggests that prophylactic antibiotics should not be routinely held until tissue for culture is obtained (see Section 2.5. Diagnosis: Sampling, Question 7). Intravenous antibiotics should only be continued for 24 hours postoperatively, unless there is a concern for periprosthetic infection. Antibiotics can be continued up until final culture results are obtained in revision cases if there is some suspicion of infection while awaiting the final culture results.

LEVEL OF EVIDENCE: Moderate

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

RATIONALE

Primary Shoulder Arthroplasty

Prophylactic IV antibiotics should be started within one hour prior

to incision to decrease the risk of infection [1–7]. IV antibiotics may be continued for 24 hours postoperatively [5–7].

However, recent recommendations from the Center for Disease Control and Prevention (CDC) suggest that prophylactic antibiotics should be administered such that a bactericidal concentration is present in the serum and tissues prior to incision and additional prophylactic antibiotic treatment should not be administered after the surgical incision is closed for clean and clean-contaminated procedures even in the presence of a drain [8]. Similar recommendations have recently been proposed by the World Health Organization advocating preoperative antibiotic prophylaxis without postoperative dosing [9].

Revision Shoulder Arthroplasty

IV antibiotics should be started within one hour prior to incision. There remains some controversy regarding whether or not to administer antibiotics prior to obtaining cultures in the revision setting. Based upon previous experience with revision shoulder arthroplasty [10], McGoldrick et al. recommended withholding prophylactic antibiotics until after tissue cultures have been obtained especially in cases “that have no overt preoperative evidence of clinical infection” [11]. Nevertheless, there is some evidence suggesting that withholding prophylactic IV antibiotics prior to revision for obvious or highly suspected infection is not needed, but this is mostly reported from the hip and knee arthroplasty literature [12,13]. Routine prophylactic IV antibiotics should only be continued for 24 hours postoperatively, unless there is a concern for periprosthetic infection in which case IV or oral antibiotics can be continued for up to 3 weeks postoperatively while awaiting the final culture results [12,14,15]. *C. acnes* may require 13-17 days to grow, necessitating antibiotics for 2 weeks following revision arthroplasty with a concern for periprosthetic joint infection [11,14-18].

Re-dosing of prophylactic antibiotics has been recommended for procedures lasting longer than 3-4 hours [19,20], although there are no shoulder arthroplasty studies on re-dosing of antibiotics.

Note: Despite appropriate skin prep and preoperative IV antibiotics, *C. acnes* can still be grown from the native tissue of the shoulder including within the glenohumeral joint in patients without prior surgery [17,21,22].

Shoulder Surgery Articles: 9 Studies

- 0 – Level I studies
- 0 – Prognostic Level II studies
- 4 – Retrospective Cohort Level III studies
- 3 – Case Series Level IV studies
- 2 – Level V opinion

TKA/THA/Other Surgical Articles: 12 Studies

- 1 – Level I studies
- 1 – Prognostic Level II studies
- 4 – Retrospective Cohort Level III studies
- 3 – Case Series Level IV studies
- 3 – Level V opinion

REFERENCES

[1] Bratzler DW, Houck PM, Surgical Infection Prevention Guidelines Writers Workgroup, American Academy of Orthopaedic Surgeons, American Association of Critical Care Nurses, American Association of Nurse Anesthetists, et al. Antimicrobial prophylaxis for surgery: an advisory statement from the National Surgical Infection Prevention Project. *Clin Infect Dis*. 2004;38:1706-1715. doi:10.1086/421095.

[2] Classen DC, Evans RS, Pestotnik SL, Horn SD, Menlove RL, Burke JP. The timing of prophylactic administration of antibiotics and the risk of surgical-wound infection. *N Engl J Med*. 1992;326:281-286. doi:10.1056/NEJM199201303260501.

[3] Garey KW, Dao T, Chen H, Amrutkar P, Kumar N, Reiter M, et al. Timing of vancomycin prophylaxis for cardiac surgery patients and the risk of surgical site infections. *J Antimicrob Chemother*. 2006;58:645-650. doi:10.1093/jac/dkl279.

[4] Pauzenberger L, Grieb A, Hexel M, Laky B, Anderl W, Heuberger P. Infections following arthroscopic rotator cuff repair: incidence, risk factors, and prophylaxis. *Knee Surg Sports Traumatol Arthrosc*. 2017;25:595-601. doi:10.1007/s00167-016-4202-2.

[5] Stone HH, Hooper CA, Kolb LD, Geheber CE, Dawkins EJ. Antibiotic prophylaxis in gastric, biliary and colonic surgery. *Ann Surg*. 1976;184:443-452.

[6] Stowers MDJ, Lemanu DP, Coleman B, Hill AG, Munro JT. Review article: Perioperative care in enhanced recovery for total hip and knee arthroplasty. *J Orthop Surg (Hong Kong)*. 2014;22:383-392. doi:10.1177/230949901402200324.

[7] van Kasteren MEE, Manniën J, Ott A, Kullberg B-J, de Boer AS, Gyssens IC. Antibiotic prophylaxis and the risk of surgical site infections following total hip arthroplasty: timely administration is the most important factor. *Clin Infect Dis*. 2007;44:921-927. doi:10.1086/512192.

[8] Berríos-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. *JAMA Surg*. 2017;152:784-791. doi:10.1001/jamasurg.2017.0904.

[9] Allegranzi B, Zayed B, Bischoff P, Kubilay NZ, de Jonge S, de Vries F, et al. New WHO recommendations on intraoperative and postoperative measures for surgical site infection prevention: an evidence-based global perspective. *Lancet Infect Dis*. 2016;16:e288-e303. doi:10.1016/S1473-3099(16)30402-9.

[10] Pottinger P, Butler-Wu S, Neradilek MB, Merritt A, Bertelsen A, Jette JL, et al. Prognostic factors for bacterial cultures positive for Propionibacterium acnes and other organisms in a large series of revision shoulder arthroplasties performed for stiffness, pain, or loosening. *J Bone Joint Surg Am*. 2012;94:2075-2083. doi:10.2106/JBJS.K.00861.

[11] McGoldrick E, McElvany MD, Butler-Wu S, Pottinger PS, Matsen FA. Substantial cultures of Propionibacterium can be found in apparently aseptic shoulders revised three years or more after the index arthroplasty. *J Shoulder Elbow Surg*. 2015;24:31-35. doi:10.1016/j.jse.2014.05.008.

[12] Pérez-Prieto D, Portillo ME, Puig-Verdié L, Alier A, Gamba C, Guirro P, et al. Preoperative antibiotic prophylaxis in prosthetic joint infections: not a concern for intraoperative cultures. *Diagn Microbiol Infect Dis*. 2016;86:442-445. doi:10.1016/j.diagmicrobio.2016.09.014.

[13] Wouthuyzen-Bakker M, Benito N, Soriano A. The effect of preoperative antimicrobial prophylaxis on intraoperative culture results in patients with a suspected or confirmed prosthetic joint infection: a systematic review. *J Clin Microbiol*. 2017;55:2765-2774. doi:10.1128/JCM.00640-17.

[14] Padegimas EM, Lawrence C, Narzikul AC, Zmistowski BM, Abboud JA, Williams GR, et al. Future surgery after revision shoulder arthroplasty: the impact of unexpected positive cultures. *J Shoulder Elbow Surg*. 2017;26:975-981. doi:10.1016/j.jse.2016.10.023.

[15] Shirwaiker RA, Springer BD, Spanghel MJ, Garrigues GE, Lowenberg DW, Garras DN, et al. A clinical perspective on musculoskeletal infection treatment strategies and challenges. *J Am Acad Orthop Surg*. 2015;23 Suppl:S44-S54. doi:10.5435/JAAOS-D-14-00379.

[16] Matsen FA, Butler-Wu S, Carofino BC, Jette JL, Bertelsen A, Bumgarner R. Origin of propionibacterium in surgical wounds and evidence-based approach for culturing propionibacterium from surgical sites. *J Bone Joint Surg Am*. 2013;95:e1811-e1817. doi:10.2106/JBJS.L.01733.

[17] Matsen FA, Russ SM, Bertelsen A, Butler-Wu S, Pottinger PS. Propionibacterium can be isolated from deep cultures obtained at primary arthroplasty despite intravenous antimicrobial prophylaxis. *J Shoulder Elbow Surg*. 2015;24:844-847. doi:10.1016/j.jse.2014.10.016.

[18] Shields MV, Abdullah L, Namdari S. The challenge of Propionibacterium acnes and revision shoulder arthroplasty: a review of current diagnostic options. *J Shoulder Elbow Surg*. 2016;25:1034-1040. doi:10.1016/j.jse.2016.01.009.

[19] Scher KS. Studies on the duration of antibiotic administration for surgical prophylaxis. *Am Surg*. 1997;63:59-62.

[20] Steinberg JP, Braun BI, Hellinger WC, Kusek L, Bozikis MR, Bush AJ, et al. Timing of antimicrobial prophylaxis and the risk of surgical site infections: results from the Trial to Reduce Antimicrobial Prophylaxis Errors. *Ann Surg*. 2009;250:10-16. doi:10.1097/SLA.0b013e3181ad5fca.

[21] Falconer TM, Baba M, Kruse LM, Dorrestijn O, Donaldson MJ, Smith MM, et al. Contamination of the surgical field with Propionibacterium acnes in primary shoulder arthroplasty. *J Bone Joint Surg Am*. 2016;98:1722-1728. doi:10.2106/JBJS.15.01133.

[22] Mook WR, Klement MR, Green CL, Hazen KC, Garrigues GE. The incidence of Propionibacterium acnes in open shoulder surgery: a controlled diagnostic study. *J Bone Joint Surg Am*. 2015;97:957-963. doi:10.2106/JBJS.N.00784.