without the use of implants or grafts in the healthy patient, there is no evidence to support the use of perioperative antibiotic prophylaxis. Antibiotics may be considered when implants are being used or when the patient has certain comorbidities which are considered risk factors for infection. A first- or second-generation cephalosporin antibiotic can be used as a first line agent, including in patients with a non-anaphylactic penicillin allergy. In patients with an anaphylactic penicillin allergy, other agents such as vancomycin, clindamycin or teicoplanin can be considered.

REFERENCES

[1] Clement RC, Haddix KP, Creighton RA, Spang JT, Tennant JN, Kamath GV. Risk factors for infection after knee arthroscopy: analysis of 595,083 cases from 3 United States databases. Arthroscopy. 2016;32:2556–2561. doi:10.1016/j.arthro.2016.04.026.

[2] Cancienne JM, Mahon HS, Dempsey IJ, Miller MD, Werner BC. Patient-related risk factors for infection following knee arthroscopy: an analysis of over 700,000 patients from two large databases. Knee. 2017;24:594–600. doi:10.1016/j.knee.2017.02.002.

[3] Sherman OH, Fox MJ, Snyder JS, Del Pizzo J W, Friedman DM, Ferkel JR, et al. An analysis of complications in two thousand six hundred and forty cases. J Bone Joint Surg Am. 1986;68:256–265.

[4] Randelli P, Castagna A, Cabitza F, Cabitza P, Arrigoni P, Denti M. Infectious and thromboembolic complications of arthroscopic shoulder surgery. J Shoulder Elbow Surg. 2010;19:97–101. doi:10.1016/j.jse.2009.04.009.

[5] Weber SC, Abrams JS, Nottage WM. Complications associated with arthroscopic shoulder surgery. Arthroscopy. 2002;18:88–95. doi:10.1053/jars.2002.31801.

[6] Qi Y, Yang X, Pan Z, Wang H, Chen L. Value of antibiotic prophylaxis in routine knee arthroscopy. Der Orthopäde. 2018;47:246–253. doi:10.1007/s00132-017-3486-3.

[7] Wieck JA, Jackson JK, O'Brien TJ, Lurate RB, Russell JM, Dorchak JD. Efficacy of prophylactic antibiotics in arthroscopic surgery. Orthopedics. 1997;20:133–134.

[8] Wyatt RWB, Maletis GB, Lyon LL, Schwalbe J, Avins AL. Efficacy of prophylactic antibiotics in simple knee arthroscopy. Arthroscopy. 2017;33:157–162. doi:10.1016/j.arthro.2016.05.020.

[9] Bert JM, Giannini D, Nace L. Antibiotic prophylaxis for arthroscopy of the knee: is it necessary? Arthroscopy. 2007;23:4–6. doi:10.1016/j.arthro.2006.08.014.

[10] Pauzenberger L, Grieb A, Hexel M, Laky B, Anderl W, Heuberer 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.

[11] Hansen E, Belden K, Silibovsky R, Vogt M, Arnold W, Bicanic G, et al. Perioperative antibiotics. J Orthop Res. 2014;32 Suppl 1:S31–S59. doi:10.1002/jor.22549.

[12] Hill C, Flamant R, Mazas F, Evrard J. Prophylactic cefazolin versus placebo in total hip replacement. Report of a multicentre double-blind randomised trial. Lancet. 1981;1:795–796.

[13] Tyllianakis ME, Karageorgos AC, Marangos MN, Saridis AG, Lambiris EE. Antibiotic prophylaxis in primary hip and knee arthroplasty: comparison between cefuroxime and two specific antistaphylococcal agents. J Arthroplasty. 2010;25:1078–1082. doi:10.1016/j.arth.2010.01.105.

[14] Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm. 2013;70:195–283. doi:10.2146/ajhp120568.

[15] Hickson CJ, Metcalfe D, Elgohari S, Oswald T, Masters JP, Rymaszewska M, et al. Prophylactic antibiotics in elective hip and knee arthroplasty: an analysis of organisms reported to cause infections and national survey of clinical practice. Bone Joint Res. 2015;4:181–189. doi:10.1302/2046-3758.411.2000432.

[16] Balato G, Di Donato SL, Ascione T, D'Addona A, Smeraglia F, Di Vico G, et al. Knee septic arthritis after arthroscopy: incidence, risk factors, functional outcome, and infection eradication rate. Joints. 2017;5:107–113. doi:10.1055/s-0037-1603901.

[17] Armstrong RW, Bolding F, Joseph R. Septic arthritis following arthroscopy: Clinical syndromes and analysis of risk factors. Arthroscopy. 1992;8:213–223. doi:10.1016/0749-8063(92)90039-E.

[18] Bohensky MA, Ademi Z, Desteiger R, Liew D, Sundararajan V, Bucknill A, et al. Quantifying the excess cost and resource utilisation for patients with complications associated with elective knee arthroscopy: A retrospective cohort study. Knee. 2014;21:491–496. doi:10.1016/j.knee.2013.11.009.

[19] Tacconelli E, Carrara E, Savoldi A, Harbarth S, Mendelson M, Monnet DL, et al. Discovery, research, and development of new antibiotics: the WHO priority list of antibiotic-resistant bacteria and tuberculosis. Lancet. 2018;18:318–327. doi:10.1016/S1473-3099(17)30753-3.

Authors: Nirav K. Patel, Andy O. Miller

QUESTION 2: Should routine methicillin-resistant *Staphylococcus aureus* (MRSA) screening be in place for patients undergoing elective sports procedures?

RECOMMENDATION: Routine MRSA screening is not warranted for patients undergoing elective sports procedures. Screening may be appropriate in higher-risk patients and patients undergoing more complex procedures.

LEVEL OF EVIDENCE: Consensus

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

RATIONALE

Staphylococcus aureus (*S. aureus*) is the most frequent pathogen isolated from surgical site infections (SSIs) in patients undergoing orthopaedic procedures [1]. SSIs caused by *S. aureus* can be serious and difficult to treat, often requiring debridement with removal of orthopaedic implants. *S. aureus* resides on skin surfaces and asymptomatically colonizes approximately one-third of the population, most commonly the anterior nares [2]. Multiple studies have shown that *S. aureus* nasal colonization is a significant risk factor in developing *S. aureus* SSIs [3]. *S. aureus* is also found in the throat, axilla and groin [4], as well as in eczematous skin lesions [5]. Screening for and decolonization of *S. aureus* has been shown to decrease SSI rates in a variety of surgical specialties [6], but not specifically in patients undergoing sports procedures.

In some hospitals, 57% of isolates of *S. aureus* causing orthopaedic infection are resistant to methicillin [1]. Compared to methicillin-sensitive *S. aureus* (MSSA) causing SSI, patients with MRSA SSIs have been shown to have a higher risk of morbidity, mortality and greater hospital costs [7]. Indeed, one study showed that intranasal carriage of *S. aureus* was the only independent risk factor for SSIs following orthopaedic implant surgery [8].

Most studies evaluating MRSA screening and decolonization in orthopaedic patients were performed in elective total joint arthroplasty patients [9,10]. Other studies have also included spine patients (e.g., fusion) and trauma patients [11], and many did not state the specific type of elective orthopaedic patient included. These non-specific studies often had a minimum inpatient stay inclusion criterion, which therefore excludes almost all elective orthopaedic sports surgery cases.

Our extensive search of the literature identified a study by Kim et al. that evaluated patients undergoing sports procedures who

screened 7,019 of 7,338 (95.6%) preoperatively for MRSA. They also included patients undergoing total joint replacement and spine surgery, with a minimum one-day inpatient stay, though no details on the types of cases or numbers were provided. There were 309 (4.4%) MRSA carriers, and these patients did have a significantly higher risk of SSI compared to non-MRSA carriers (0.97% vs. 0.14%, p = 0.0162). However, the rates of infection in the sports surgery group were not reported [3].

Given the significant lack of data on the efficacy and cost effectiveness of preoperative MRSA screening in patients undergoing orthopaedic procedures in general and those receiving sports procedures in particular, the routine practice of MRSA screening cannot be recommended. Rates of infection after sports surgery procedures are generally lower than rates after arthroplasty or spine procedures, suggesting that screening strategies may prevent fewer infections and be less cost-effective in sports surgery than in other orthopaedic procedures. Very limited data suggests that screening may be considered in sports patients who will be admitted for at least one overnight stay, particularly if implants are to be used [3]. Further studies are needed to evaluate the efficacy and cost-effectiveness of screening for Staphylococcal carriage (MRSA or MSSA) in patients undergoing sports surgery procedures.

REFERENCES

[1] Shams WE, Rapp RP. Methicillin-resistant staphylococcal infections: an important consideration for orthopedic surgeons. Orthopedics. 2004;27:565–568.

[2] Chen AF, Wessel CB, Rao N. Staphylococcus aureus screening and decolonization in orthopaedic surgery and reduction of surgical site infections. Clin Orthop Relat Res. 2013;471:2383–2399. doi:10.1007/s11999-013-2875-0.

[3] Kim DH, Spencer M, Davidson SM, Li L, Shaw JD, Gulczynski D, et al. Institutional prescreening for detection and eradication of methicillin-resistant Staphylococcus aureus in patients undergoing elective orthopaedic surgery. J Bone Joint Surg Am. 2010;92:1820–1826. doi:10.2106/JBJS.I.01050.

[4] Gorwitz RJ, Kruszon-Moran D, McAllister SK, McQuillan G, McDougal LK, Fosheim GE, et al. Changes in the prevalence of nasal colonization with Staphylococcus aureus in the United States, 2001-2004. J Infect Dis. 2008;197:1226–1234. doi:10.1086/533494.

[5] Abeck D, Mempel M. Staphylococcus aureus colonization in atopic dermatitis and its therapeutic implications. Br J Dermatol. 1998;139 Suppl 53:13–16.

[6] Bode LGM, Kluytmans JAJW, Wertheim HFL, Bogaers D, Vandenbroucke-Grauls CMJE, Roosendaal R, et al. Preventing surgical-site infections in nasal carriers of Staphylococcus aureus. N Engl J Med. 2010;362:9–17. doi:10.1056/NEJMoa0808939.

[7] 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;23:183–189. doi:10.1086/502033.

[8] Kalmeijer MD, van Nieuwland-Bollen E, Bogaers-Hofman D, de Baere GA. Nasal carriage of Staphylococcus aureus is a major risk factor for surgical-site infections in orthopedic surgery. Infect Control Hosp Epidemiol. 2000;21:319–323. doi:10.1086/501763.

[9] Walley G, Orendi J, Bridgman S, Davis B, Ahmed E-N, Maffulli N. Methicillin resistant Staphylococcus aureus (MRSA) is not always caught on the orthopaedic ward. Acta Orthop Belg. 2009;75:245–251.

[10] Murphy E, Spencer SJ, Young D, Jones B, Blyth MJG. MRSA colonisation and subsequent risk of infection despite effective eradication in orthopaedic elective surgery. J Bone Joint Surg Br. 2011;93:548–551. doi:10.1302/0301-620X.93B4.24969.

[11] Mehta S, Hadley S, Hutzler L, Slover J, Phillips M, Bosco JA. Impact of preoperative MRSA screening and decolonization on hospital-acquired MRSA burden. Clin Orthop Relat Res. 2013;471:2367–2371. doi:10.1007/s11999-013-2848-3.

Authors: Jacek Kruczyński, António Nogueira de Sousa, Pawel Chodór, Tomasz Andrzejewski, Paweł Kokoszka, Luisa Vital, Joao Lobo

QUESTION 3: What perioperative antibiotic prophylaxis should be used in patients undergoing arthroscopic surgery who are methicillin-resistant *Staphylococcus aureus* (MRSA) carriers?

RECOMMENDATION: MRSA carriers should be administered vancomycin or teicoplanin as antibiotic prophylaxis prior to arthroscopic surgery involving an implant and/or a graft or for patients at higher risk of infection.

LEVEL OF EVIDENCE: Consensus

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

RATIONALE

Prevalence of MRSA colonization is increasing in some community settings, even in patients who lack traditional (or any) identifiable risk factors [1]. Surveillance studies have suggested that the colonization rate in the general population varies worldwide, with methicillin-sensitive *S. aureus* (MSSA) nasal carriers making up 20–36.4% of the population, and MRSA nasal colonization composing 0.6–6% of the population [2].

When simple arthroscopy is performed (meniscal tears, articular debridement, synovectomy and microfracture), the risk of surgical site infection (SSI) is extremely low and antimicrobial prophylaxis is not routinely recommended [3–7]. However, when arthroscopic procedures involve the use of implants, grafts, placement of several surgical incisions, prolonged operative time or knee ligament reconstruction, the SSI risk is higher than in simple arthroscopy, and prophylactic antibiotic administration may be justified [8–10]. Although the efficacy of prophylactic antibiotics in reducing SSI for major orthopaedic procedures has been proven, the role of antibiotic prophylaxis in routine arthroscopy remains controversial [3,4,11,12].

Regarding arthroplasty, some studies reveal that universal MRSA decolonization is effective in reducing the overall rate of SSIs and promoting economic gains for the health system related to the downstream savings accrued from limiting future reoperations and hospitalizations [13–15]. The American Academy of Orthopaedic Surgeons (AAOS) and Surgical Care Improvement Project (SCIP) recommend first- or second-generation cephalosporins as the prophylactic antibiotics of choice for patients who are not colonized with MRSA, with vancomycin prophylaxis reserved for those who are MRSA-colonized [16]. The addition of vancomycin or an aminoglycoside to the prophylactic perioperative antibiotic regimen results in a predicted activity of 83–97% against the most common pathogens causing SSIs [17].

Thus, based on the available evidence, it is unlikely that prophylactic antibiotics are needed for simple arthroscopic procedures