

HK30: Do immunocompromised patients with Prosthetic Joint Infection have a different microorganism profile?

Humberto Gonzalez Ugalde, Jenny R. Aronson, Guillermo Bonilla Leon, Ferdinando Da Rin de Lorenzo, Eleftherios Tsiridis, Marjan Wouthuyzen-Bakker, Feras Ya'ish

Response/Recommendation: Immunocompromised patients have a higher chance of developing opportunistic infections and atypical pathogens, and this should be taken into consideration when routine cultures remain negative.

Level of Evidence: Limited

Delegate Vote:

Rationale:

While we understand that immunocompromised patients face a higher risk for infection, the microorganism causing periprosthetic joint infection (PJI) in this patient population is not well studied. It is known that immunocompromised patients are at higher risk for developing infections with opportunistic and atypical pathogens (REF), but due to the lack of adequate studies reporting the rate of infection with these atypical infections in non-immunocompromised patients, the evidence behind such claims is weak.

In order to answer the question posed above, we performed a comprehensive systematic review using appropriate MeSH terms developed by librarians. The initial search yielded 396 papers, from which 127 studies were selected for analysis. Out of these, 61 studies met the inclusion criteria and were reviewed in full for data extraction. Most of the studies reviewed were case reports, some of which were associated with a literature review, providing insights into the number of cases involving atypical organisms in the literature.

Studies comparing the microorganism profile of PJI between immunocompromised patients and non-immunocompromised patients are lacking. However, most observational studies describing the epidemiology of PJI comprise immunocompromised patients, and the reported causative microorganisms often do not include opportunistic pathogens. Therefore, the overall microorganism profiles in both groups are probably similar, although they can have a more severe course compared to the non-immunocompromised host. However, opportunistic infections and atypical or rare microorganisms can occur in immunocompromised patients who have PJI, as illustrated in many case reports (Table 1). Rare and/or opportunistic pathogens that have been described in immunocompromised hosts are Salmonella, mycobacteria, Listeria, Campylobacter, Mycoplasma, and Pasteurella (23), (19)

It is important to determine the degree of immunodeficiency in a patient who has a PJI. Diaz-Ledezma et al. emphasize the importance of the immune status as a key factor in the pathophysiological process of PJI. (14) Systemic host grades (medical and immune status) are categorized as Uncompromised (no compromising factors), Compromised (one to two compromising factors), or Significantly Compromised (two compromising factors along with another factor such as an absolute neutrophil count <1,000, CD4 T cell count <100,

intravenous drug abuse, chronic active infection at another site, dysplasia, or neoplasm of the immune system) (1). The systemic host-compromising factors (medical and immune) include age > 80 years, alcoholism, chronic active dermatitis or cellulitis, chronic indwelling catheter, chronic malnutrition (albumin $\leq$ 3.0 g/dL), current nicotine use (inhalational or oral), diabetes (requiring oral agents and/or insulin), hepatic insufficiency (cirrhosis), immunosuppressive drugs (methotrexate, prednisone, cyclosporine), malignancy (history of or active), and pulmonary insufficiency (room air arterial blood gas O₂).

In addition, immunosuppression and systemic diseases have been reported as risk factors for invasive fungal infections. In the review of Koutserimpas et al., 40.4% of patients who have a fungal PJI were immunocompromised, mostly due to diabetes mellitus (53.8%) (27).

In conclusion, although immunocompromised patients with PJI have similar microorganism profiles as non-immunocompromised patients with PJI, good case-control studies are lacking. However, immunocompromised patients do have a higher chance of developing opportunistic pathogens. For this reason, rare causative pathogens should always be considered, particularly in culture-negative cases.

References:

1. McPherson EJ, Woodson C, Holtom P, Roidis N, Shufelt C, Patzakakis M. Periprosthetic total hip infection: outcomes using a staging system. *Clin Orthop Relat Res*. 2002 Oct(403):8–15.
2. AF, M., OD, S., Vlasits, K., & PJ, P. (n.d.). Late hip arthroplasty infection caused by *Listeria monocytogenes* in a non-immunocompromised patient. *Surg Infect (Larchmt)*, 12(2 PG-137–40), 137–140. <https://doi.org/10.1089/sur.2010.011>
3. AL, R., AL, H., Yu, J., MH, N., PD, F., & PC, I. (n.d.). *Streptococcus pneumoniae* serotype 6C presenting as recurrent prosthetic knee joint infection in a patient with a history of congenital asplenia and underlying autoimmune disease: a case report and literature review. *Diagn Microbiol Infect Dis*, 77(4 PG-376–9), 376–379. <https://doi.org/10.1016/j.diagmicrobio.2013.09.011>
4. AN, L., RR, R., & AD, H. (n.d.). *Capnocytophaga canimorsus* a novel pathogen for joint arthroplasty. *Clin Orthop Relat Res*, 467(6 PG-1634–8), 1634–1638. <https://doi.org/10.1007/s11999-008-0658-9>
5. BH, H., SC, L., Ong, A., HS, A., & SH, M. (n.d.). Mycobacterial periprosthetic joint infection after primary total knee arthroplasty. *Int Orthop*, 45(12 PG-3055–3062), 3055–3062. <https://doi.org/10.1007/s00264-021-05029-x>
6. Brassinne, L., Rodriguez-Villalobos, H., Jonckheere, S., JE, D., & JC, Y. (n.d.). Early infection of hip joint prosthesis by *Clostridium difficile* in an HIV-1 infected patient. *Anaerobe*, 27(PG-96-9), 96–99. <https://doi.org/10.1016/j.anaerobe.2014.03.007>
7. Brown, A., Grubbs, P., & AB, M. (n.d.). Infection of total hip prosthesis by *Mycobacterium tuberculosis* and *Mycobacterium chelonae* in a patient with rheumatoid arthritis. *Clin Rheumatol*, 27(4 PG-543–5), 543–545. <https://doi.org/10.1007/s10067-007-0788-6>
8. Bubonja-Sonje, M., Rubinic, D., Anic, F., Novak, S., Vuckovic, D., & Abram, M. (n.d.). *Salmonella enterica* arthritis in a patient with rheumatoid arthritis receiving anti-tumour necrosis factor therapy. *West Indian Med J*, 62(3 PG-270–2), 270–272. NS -

8. Charlier, C., Leclercq, A., Cazenave, B., Desplaces, N., Travier, L., Cantinelli, T., Lortholary, O., Goulet, V., A, L. M., & Lecuit, M. (n.d.). *Listeria monocytogenes*-associated joint and bone infections: a study of 43 consecutive cases. *Clin Infect Dis*, 54(2 PG-240–8), 240–248. <https://doi.org/10.1093/cid/cir803>
9. Chen, Y., Huang, Z., Fang, X., Li, W., Yang, B., & Zhang, W. (n.d.). Diagnosis and treatment of mycoplasmal septic arthritis: a systematic review. *Int Orthop*, 44(2 PG-199–213), 199–213. <https://doi.org/10.1007/s00264-019-04451-6>
10. CL, H., TM, R., RW, M., SM, O., TK, F., BD, S., & JE, O. (n.d.). Treatment Outcomes of Fungal Periprosthetic Joint Infection. *J Arthroplasty*, 38(11 PG-2436-2440.e1), 2436-2440.e1. <https://doi.org/10.1016/j.arth.2023.05.009>
11. CMR, D., JS, H., Damodaran, P., & NN, S. (n.d.). Total hip arthroplasty infection caused by an unusual organism, *Salmonella*; its successful management and literature review. *BMJ Case Rep*, 2018(PG-). <https://doi.org/10.1136/bcr-2018-224792>
12. Cobo, F., Rodríguez-Granger, J., EM, L., Jiménez, G., Sampedro, A., Aliaga-Martínez, L., & JM, N.-M. (n.d.). *Candida*-induced prosthetic joint infection. A literature review including 72 cases and a case report. *Infect Dis (Lond)*, 49(2 PG-81–94), 81–94. <https://doi.org/10.1080/23744235.2016.1219456>
13. CY, S., & HY, C. (n.d.). *Pasteurella multocida* in total knee prosthetic joint infection caused by cat scratches and bites in a liver transplant recipient. *IDCases*, 29(PG-e01560), e01560. <https://doi.org/10.1016/j.idcr.2022.e01560>
14. Diaz-Ledezma, C., Baker, J., & Parvizi, J. (n.d.). “Warning signs” of primary immunodeficiency among patients with periprosthetic joint infection. *J Appl Biomater Funct Mater*, 12(2 PG-65–9), 65–69. <https://doi.org/10.5301/jabfm.5000207>
15. DL, P., CJ, W., CE, D., JO, B., ML, S., & ME, E. (n.d.). Knee and hip arthroplasty infection rates in persons with haemophilia: a 27 year single center experience during the HIV epidemic. *Haemophilia*, 11(3 PG-233–9), 233–239. <https://doi.org/10.1111/j.1365-2516.2005.01081.x>
16. Franco-Cendejas, R., CA, C.-C., Hernández-Durán, M., LE, L.-J., Ortega-Peña, S., Cerón-González, G., Vanegas-Rodríguez, S., JA, M.-E., & Acosta-Rodríguez, E. (n.d.). *Leuconostoc mesenteroides* periprosthetic knee infection, an unusual fastidious Gram-positive bacteria: a case report. *BMC Infect Dis*, 17(1 PG-227), 227. <https://doi.org/10.1186/s12879-017-2315-y>
17. Galanis, A., Karampitianis, S., Vlamis, J., Karampinas, P., Vavourakis, M., Vlachos, C., Papagrigorakis, E., Zachariou, D., Sakellariou, E., Varsamos, I., Patilas, C., Tsiplakou, S., Papaioannou, V., & Kamariotis, S. (n.d.). *Corynebacterium striatum* Periprosthetic Hip Joint Infection: An Uncommon Pathogen of Concern? *Healthcare (Basel)*, 12(2 PG-). <https://doi.org/10.3390/healthcare12020273>
18. Gaston, G., & Ogden, J. (n.d.). *Candida glabrata* periprosthetic infection: a case report and literature review. *J Arthroplasty*, 19(7 PG-927–30), 927–930. <https://doi.org/10.1016/j.arth.2004.04.012>
19. Gebauer, M., Frommelt, L., Achan, P., Board, T. N., Conway, J., Griffin, W., Heidari, N., Kerr, G., McLaren, A., Nelson, S. B., Nijhof, M., & Zahar, A. (2014). Management of Fungal or Atypical Periprosthetic Joint Infections. *Journal of Arthroplasty*, 29(2 SUPPL.), 112–114. <https://doi.org/10.1016/j.arth.2013.09.049>
20. Gupta, A., & Clauss, H. (n.d.). Prosthetic joint infection with *Mycobacterium avium* complex in a solid organ transplant recipient. *Transpl Infect Dis*, 11(6 PG-537–40), 537–540. <https://doi.org/10.1111/j.1399-3062.2009.00433.x>

21. Gupta, A., EF, B., DR, O., & Virk, A. (n.d.). Prosthetic joint infection due to *Salmonella* species: a case series. *BMC Infect Dis*, 14(PG-633), 633. <https://doi.org/10.1186/s12879-014-0633-x>
22. Han, Z., CA, B., Clohisy, J., & Babcock, H. (n.d.). *Mycoplasma pneumoniae* periprosthetic joint infection identified by 16S ribosomal RNA gene amplification and sequencing: a case report. *J Bone Joint Surg Am*, 93(18 PG-e103), e103. <https://doi.org/10.2106/JBJS.K.00318>
23. I, U. H., TA, K., & Krukiewicz, K. (n.d.). Etiology, pathology, and host-impaired immunity in medical implant-associated infections. *J Infect Public Health*, 17(2 PG-189–203), 189–203. <https://doi.org/10.1016/j.jiph.2023.11.024>
24. Ji, B., Zhang, X., Xu, B., Ren, J., Guo, W., Mu, W., & Cao, L. (n.d.). The fate of immunocompromised patients in the treatment of chronic periprosthetic joint infection: a single-centre experience. *Int Orthop*, 42(3 PG-487–498), 487–498. <https://doi.org/10.1007/s00264-018-3763-8>
25. Johannsson, B., & JJ, C. (n.d.). Prosthetic hip infection due to *Cryptococcus neoformans*: case report. *Diagn Microbiol Infect Dis*, 64(1 PG-76–9), 76–79. <https://doi.org/10.1016/j.diagmicrobio.2009.01.005>
25. JT, B., GR, W., McDonnell, M., SA, F., RA, H., & CT, B. (n.d.). Fungal osteomyelitis and septic arthritis. *J Am Acad Orthop Surg*, 22(6 PG-390–401), 390–401. <https://doi.org/10.5435/JAAOS-22-06-390>
26. JW, H., & Ahmed, S. (n.d.). *Plesiomonas shigelloides* Periprosthetic Knee Infection After Consumption of Raw Oysters. *Am J Orthop (Belle Mead NJ)*, 46(1 PG-32–34), E32–E34. NS -
27. Koutserimpas, C., Naoum, S., Giovanoulis, V., Raptis, K., Alpantaki, K., Dretakis, K., Vrioni, G., & Samonis, G. (n.d.). Fungal Periprosthetic Hip Joint Infections. *Diagnostics (Basel)*, 12(10 PG-). <https://doi.org/10.3390/diagnostics12102341>
28. Kuthan, R., GL, Z.-W., Ott, F., & Soltaninia, D. (n.d.). Septic Obturation of a Knee Endoprosthesis Caused by *Aspergillus clavatus*. *Pathogens*, 12(10 PG-). <https://doi.org/10.3390/pathogens12101270>
29. LA, C., AO, F., & JM, H. (n.d.). Is *Listeria monocytogenes* an important pathogen for prosthetic joints? *J Clin Rheumatol*, 7(1 PG-34–7), 34–37. <https://doi.org/10.1097/00124743-200102000-00008>
30. Losada, I., Rita, M., Freire, M., & Graña, G. (n.d.). [Relapsing *Staphylococcus lugdunensis* septic arthritis associated with a knee prosthesis]. *Enferm Infecc Microbiol Clin*, 21(4 PG-214), 214. [https://doi.org/10.1016/s0213-005x\(03\)72921-8](https://doi.org/10.1016/s0213-005x(03)72921-8)
31. Madan, S., Abbas, D., RL, J., & Mounce, K. (n.d.). *Salmonella enteritidis* infection in total knee replacement. *Rheumatology (Oxford)*, 40(1 PG-112–3), 112–113. <https://doi.org/10.1093/rheumatology/40.1.112>
32. Mahmood, M., Ajmal, S., OM, A. S., Bryson, A., JR, M., & JW, W. (n.d.). *Mycobacterium genavense* infections in non-HIV immunocompromised hosts: a systematic review. *Infect Dis (Lond)*, 50(5 PG-329–339), 329–339. <https://doi.org/10.1080/23744235.2017.1404630>
33. MC, P., RW, F., & Castiglia, M. (n.d.). Prosthetic hip infection and bacteremia due to *Campylobacter jejuni* in a patient with AIDS. *Clin Infect Dis*, 16(3 PG-439–40), 439–440. <https://doi.org/10.1093/clind/16.3.439>
34. ME, L., Ader, F., Dumistrescu, O., Servien, E., Saison, J., Ferry, T., Chidiac, C., & Valour, F. (n.d.). *Mycobacterium bovis* prosthetic joint infection. *Med Mal Infect*, 46(8 PG-445–448), 445–448. <https://doi.org/10.1016/j.medmal.2016.07.005>

35. Mehta, H., & Mackie, I. (n.d.). Prosthetic joint infection with *Pasturella multocida* following cat scratch: a report of 2 cases. *J Arthroplasty*, 19(4 PG-525–7), 525–527. <https://doi.org/10.1016/j.arth.2003.11.012>
36. MJ, Z.-L., Álvarez-García, P., & García-Campello, M. (n.d.). Prosthetic hip joint infection caused by *Campylobacter fetus*: A case report and literature review. *Rev Esp Quimioter*, 31(1 PG-53–57), 53–57. NS -
37. MM, O., MAA, A., Janardhanan, R., & Kumar, V. (n.d.). Uncommon Pathogen: *Achromobacter xylosoxidans* Infection Following Total Knee Arthroplasty. *J Orthop Case Rep*, 14(5 PG-28–31), 28–31. <https://doi.org/10.13107/jocr.2024.v14.i05.4422>
38. Mondon, D., Bouillet, B., Lesens, O., & Descamps, S. (n.d.). [First report of a total knee arthroplasty infected by *Pasteurella canis*]. *Med Mal Infect*, 40(10 PG-600–1), 600–601. <https://doi.org/10.1016/j.medmal.2010.02.006>
39. Morchón, D., Tejedor, M., Quereda, C., Navas, E., & Meseguer, M. (n.d.). [*Listeria monocytogenes* prosthetic joint infection: Case report and review of the literature]. *Enferm Infecc Microbiol Clin*, 27(7 PG-389–93), 389–393. <https://doi.org/10.1016/j.eimc.2008.05.007>
40. NB, S., Shoham, S., & Nayak, S. (n.d.). *Cryptococcus neoformans* prosthetic joint infection: case report and review of the literature. *Mycopathologia*, 179(3-4 PG-275–8), 275–278. <https://doi.org/10.1007/s11046-014-9847-0>
41. Noussair, L., Salomon, E., F, E. S., Duran, C., Bouchand, F., AL, R., JL, G., Bauer, T., Rottman, M., & Dinh, A. (n.d.). Monomicrobial bone and joint infection due to *Corynebacterium striatum*: literature review and amoxicillin-rifampin combination as treatment perspective. *Eur J Clin Microbiol Infect Dis*, 38(7 PG-1269–1278), 1269–1278. <https://doi.org/10.1007/s10096-019-03542-x>
42. Orth, M., Orth, P., & Anagnostakos, K. (n.d.). *Capnocytophaga canimorsus* - An underestimated cause of periprosthetic joint infection? *Knee*, 24(4 PG-876–881), 876–881. <https://doi.org/10.1016/j.knee.2017.04.011>
43. Ozan, F., ES, Ö., Duygulu, F., Çelik, İ., & Altay, T. (n.d.). Prosthetic hip joint infection caused by *Rothia dentocariosa*. *Int J Clin Exp Med*, 8(7 PG-11628–31), 11628–11631. NS -
44. Parvizi, J., TA, S., MW, P., RT, T., & ME, B. (n.d.). Total joint arthroplasty in human immunodeficiency virus-positive patients: an alarming rate of early failure. *J Arthroplasty*, 18(3 PG-259–64), 259–264. <https://doi.org/10.1054/arth.2003.50094>
45. Paziuk, T., Levicoff, E., Tan, T., & Good, R. (n.d.). Periprosthetic Joint Infection with *Listeria monocytogenes*: A Case Report. *JBJS Case Connect*, 10(2 PG-e19.00489), e19.00489. <https://doi.org/10.2106/JBJS.CC.19.00489>
46. Powell, D. L., Whitener, C. J., Dye, C. E., Ballard, J. O., Shaffer, M. L., & Eyster, M. E. (2005). Knee and hip arthroplasty infection rates in persons with haemophilia: A 27 year single center experience during the HIV epidemic. *Haemophilia*, 11(3), 233–239. <https://doi.org/10.1111/j.1365-2516.2005.01081.x>
47. Prendki, V., Marmor, S., Zeller, V., Lhotellier, L., Mégraud, F., & Desplaces, N. (n.d.). *Campylobacter* infection after prosthetic joint surgery. *Scand J Infect Dis*, 45(9 PG-706–10), 706–710. <https://doi.org/10.3109/00365548.2013.800225>
48. Radha, S., BM, S., Senevirathna, S., & JW, H. (n.d.). *Candida albicans* infection of a reverse-polarity shoulder replacement in a patient with rheumatoid arthritis treated with etanercept. *J Clin Rheumatol*, 18(6 PG-323), 323. <https://doi.org/10.1097/RHU.0b013e3182685b83>

49. Rajgopal, A., Panda, I., & Gupta, A. (n.d.). Unusual *Salmonella typhi* periprosthetic joint infection involving bilateral knees: management options and literature review. *BMJ Case Rep*, 2017(PG-). <https://doi.org/10.1136/bcr-2017-221221>
50. Rajme-López, S., MF, G.-L., Rangel-Cordero, A., & Ponce-de-León, A. (n.d.). *Histoplasma capsulatum* prosthetic joint infection. *Med Mycol Case Rep*, 40(PG-33-35), 33–35. <https://doi.org/10.1016/j.mmcr.2023.03.003>
51. Randall, D., Jee, Y., Vanood, A., & Mayo, D. (n.d.). Atypical Presentation of Periprosthetic Joint Infection After Total Knee Arthroplasty due to *Parvimonas micra*. *Arthroplast Today*, 6(4 PG-901–905), 901–905. <https://doi.org/10.1016/j.artd.2020.09.021>
52. Savini, V., Sozio, F., Catavittello, C., Talia, M., Manna, A., Febbo, F., Balbinot, A., G, D. B., Piccolomini, R., Parruti, G., & D'Antonio, D. (n.d.). Femoral prosthesis infection by *Rhodotorula mucilaginosa*. *J Clin Microbiol*, 46(10 PG-3544–5), 3544–3545. <https://doi.org/10.1128/JCM.00873-08>
53. Sebastian, S., Dhawan, B., Malhotra, R., Gautam, D., & Kapil, A. (n.d.). *Salmonella typhimurium* infection in total knee arthroplasty: A case report with review of literature. *J Lab Physicians*, 9(3 PG-217–219), 217–219. <https://doi.org/10.4103/0974-2727.208254>
54. SH, P., SH, L., CC, C., YC, L., Chang, Y., PH, H., HN, S., SWN, U., & CH, C. (n.d.). Nontuberculous mycobacteria peri-prosthetic joint infection: An outcome analysis for two stage revision arthroplasty. *J Orthop Surg (Hong Kong)*, 30(3 PG-10225536221140610), 10225536221140610. <https://doi.org/10.1177/10225536221140610>
55. Shah, N., Osmon, D., AJ, T., Steckelberg, J., Sierra, R., Walker, R., & EF, B. (n.d.). Clinical and Microbiological Characteristics of *Bacteroides* Prosthetic Joint Infections. *J Bone Jt Infect*, 2(3 PG-122–126), 122–126. <https://doi.org/10.7150/jbji.17129>
56. Sigler, R., & JR, N. (n.d.). *Mycobacterium Avium* Prosthetic Hip Infection on Abatacept Presenting as Fever of Unknown Origin. *J Bone Jt Infect*, 4(4 PG-194–197), 194–197. <https://doi.org/10.7150/jbji.35703>
57. Springer, J., & Chatterjee, S. (n.d.). *Candida albicans* prosthetic shoulder joint infection in a patient with rheumatoid arthritis on multidrug therapy. *J Clin Rheumatol*, 18(1 PG-52–3), 52–53. <https://doi.org/10.1097/RHU.0b013e31823ed485>
58. Tevell, S., Hellmark, B., Nilsson-Augustinsson, Å., & Söderquist, B. (n.d.). *Staphylococcus capitis* isolated from prosthetic joint infections. *Eur J Clin Microbiol Infect Dis*, 36(1 PG-115–122), 115–122. <https://doi.org/10.1007/s10096-016-2777-7>
59. Thoendel, M., Jeraldo, P., KE, G.-Q., Chia, N., MP, A., JM, S., DR, O., & Patel, R. (n.d.). A Novel Prosthetic Joint Infection Pathogen, *Mycoplasma salivarium*, Identified by Metagenomic Shotgun Sequencing. *Clin Infect Dis*, 65(2 PG-332–335), 332–335. <https://doi.org/10.1093/cid/cix296>
60. Tornero, E., Riba, J., & Garcia-Ramiro, S. (n.d.). Special issues involving periprosthetic infection in immunodeficiency patients. *Open Orthop J*, 7(PG-211-8), 211–218. <https://doi.org/10.2174/1874325001307010211>
61. Wensley, K., McClelland, D., Grocott, N., Manoharan, G., & Desai, S. (n.d.). Case Report: *Kingella kingae* causing prosthetic joint infection in an adult. *Access Microbiol*, 5(8 PG-). <https://doi.org/10.1099/acmi.0.000559.v3>
62. WF, A., CS, E., RP, S., WS, S., & AE, S. (n.d.). An Abrasion, a Prosthetic Shoulder, and a Cat with a Licking Tendency: Case Report and Literature Review of *P. multocida* Joint Seeding. *Case Rep Infect Dis*, 2020(PG-2842315), 2842315. <https://doi.org/10.1155/2020/2842315>