Clinics in Surgery

Short Communication
Published: 29 May, 2019

Microbiological Particularities of Surgical Site Infections in Oncologic Orthopedic Surgery Compared to Non-Oncologic Surgery-Single Center Experience and Literature Review

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Abstract

Purpose: Tumor orthopedic surgery has higher incidences of Surgical Site Infections (SSI) than non-oncologic surgery. However, their epidemiologic microbiology is rarely published.

Methods: In our large tertiary composite database of orthopedic infections, we compare SSIs in adult oncologic patients to adult non-oncologic patients.

Results: Among 2752 different first episodes of orthopedic infections in adults, only 14 (0.5%) concerned SSI at the site of prior oncologic surgery. Oncologic patients had no more prior antibiotic therapy (before intraoperative samplings) than non-oncologic patients, but they witnessed significantly more SSIs due to enterococci, Gram-negative pathogens, or infections due to multi-resistant skin commensals. In contrast, the proportion of classic orthopedic pathogens such as *Staphylococcus aureus* or *streptococci* was not different from the control group. We couldn't link the germs to prior oncologic treatment, nor to the length of perioperative surgical antibiotic prophylaxis.

Conclusion: The microbiology of orthopedic SSI in adult oncologic patients is significantly different than in non-oncologic patients. Retrospectively, the standard antibiotic prophylaxis is inadequate for the involved pathogens. More studies are needed to tailor a specific perioperative prophylaxis in terms of choice of the agents, rather than of duration of the standard prophylaxis.

Type of study/Level of evidence: III, Retrospective study.

Keywords: Microbiology; Orthopedic surgery; Oncology; Comparative epidemiology

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Received Date: *12 Apr 2019*
Accepted Date: *20 May 2019*
Published Date: *29 May 2019*

Citation:
Rod-Fleury T, Uçkay I. Microbiological Particularities of Surgical Site Infections in Oncologic Orthopedic Surgery Compared to Non-Oncologic Surgery-Single Center Experience and Literature Review. Clin Surg. 2019; 4: 2443.

Introduction

In adult orthopedic oncology, Surgical Site Infections (SSI) occurs much more frequently after interventions for Soft-Tissue (STS) or Bone Sarcoma (BS) than after non-oncologic orthopedic interventions. Their incidence might be as much as 30% [1]. Despite an emerging field of research, publications regarding their microbiology are surprisingly scant. In this study, we compared SSI in adult oncologic patients to adult non-oncologic patients and perform a literature review, which might have practical consequences in daily clinical life and future research.

Methods

Our Orthopedic Service has several databases regarding infections among adult patients [2]. Both authors retrospectively compared the epidemiology of oncologic SSI and non-oncologic SSI (first episodes) by the Pearson-χ^2, Fisher-exact or the Wilcoxon-ranksum-tests. We defined infection as pus, same positive results in several intraoperative microbiological samples, and as a clinically new local inflammation responding to systemic antibiotic therapy. We excluded colonizations and subsequent episodes of infections. For the literature search (English and French), we used the MeSH terms "sarcoma", and "postoperative complication", and "infection", with exclusion of "Kaposi", in PubMed and Google Scholar.

Results

Among 2752 different first episodes of various orthopedic infections, only 14 (0.5%) concerned

Table 1: Comparisons of microbiology of orthopaedic infections stratified upon patients with and without (prior) orthopaedic cancer at the site of infection.

n=2752	(Prior) cancer n=14	p value*	No prior cancer n=2738
Female sex	6 (43%)	0.375	870 (32%)
Median age	49 years	0.647	57 years
Prior antibiotics before sampling	3 (21%)	0.109	1168 (43%)
Median duration of prior antibiotics	1 day	0.183	4 days
Type of infection			
Osteoarticular infections	5 (36%)	0.538	1202 (44%)
Implant-related infections	2 (14%)	0.384	665 (24%)
Prosthetic joint infection	1 (7%)	0.595	321 (12%)
Bacteraemia	0 (0%)	0.174	319 (12%)
Fasciitis	0 (0%)	0.748	20 (1%)
Presence of abscesses	10 (71%)	***0.013***	1069 (39%)
Causative pathogen(s)			
Staphylococcus aureus	3 (21%)	0.098	1051 (43%)
Streptococci	2 (14%)	0.902	358 (13%)
Skin commensals	7 (50%)	***0.001***	292 (12%)
Propionibacterium acnes	0 (0%)	0.661	37 (1%)
Enterococci	6 (43%)	***0.001***	101 (4%)
Gram-negative pathogens	10 (71%)	***0.001***	567 (21%)
Anaerobes	3 (21%)	***0.001***	65 (2%)
Non-fermenting rods	9 (64%)	***0.001***	257 (11%)
Pseudomonas aeruginosa	6 (43%)	***0.001***	177 (6%)
Polymicrobial	10 (71%)	***0.001***	573 (24%)

*Significant *p* values ≤ 0.05 (two-tailed) are displayed in ***bold and italic.***

Table 2: Microbiology of infections in orthopaedic tumor surgery (selected literature).

Author, year	Journal	No. patients	Main microbiological findings				
			Polymicrobials	Skin commensals	Gram-neg	Enterococci	S aureus
Mavrogenis, 2015	Surgical infections	100	8%	47%	na	na	19%
Peel, 2014	EJSO	17	18%	35%	na	na	29%
Angelini, 2014	CORR	55	38%	na	37%	na	na
Hardes, 2010	J Surg Oncol	16	25%	25%	na	19%	6%
Lee, 2009	Ann Surg Oncol	31	na	16%	6%	3%	23%
Jeys, 2007	Ann Surg Oncol	41	na	52%	na	na	29%
Hardes, 2006	Arch Orthop Trauma Surg	29	21%	60%	14%	13%	20%
Lee, 2002	SICOT	18	0	44%	0	na	28%
Present study		14	71%	50%	71%	43%	21%

SSI at the site of prior oncologic surgery. Oncologic patients had no more prior antibiotic therapy (before intraoperative samplings) than non-oncologic patients, but witnessed a particular pattern of microorganisms, which were characterized by more enterococci, Gram-negative pathogens, or infections due to multi-resistant skin commensals. In contrast, the proportion of classic orthopedic pathogens such as *Staphylococcus aureus* or *streptococci* was not different from the control group (Table 1). Of note, we couldn't link the type of germs to prior preoperative chemotherapy or radiotherapy, nor with the length of prophylactic or prior therapeutic antibiotic therapy.

Literature Review

Of the 484 articles sorted according to our search criteria, only eight included useful microbiological data about SSI in adult orthopedic sarcomas [1,3-9]. We couldn't find a single publication specifically about the epidemiology of the pathogens in orthopedic oncology SSI. Our findings partly correspond to the literature (Table 2), however with more polymicrobial infections, Gram-negative pathogens and enterococci.

Discussion

In our adult oncologic orthopedic population, we found substantially more enterococci, Gram-negative pathogens (including *Pseudomonas aeruginosa*) and anaerobes, or infections due to multi-resistant skin commensals (except for cutibacteria) compared to non-oncologic infections [10-15]. These were mostly pathogens not covered by standard antibiotic prophylaxis. Hence, they might be

selections, in as much as the standard cephalosporin prophylaxis covers the susceptible (Gram-positive) pathogens and leaving behind these "resistant" pathogens which are typically encountered in macerations and ischemic areas. We question thus the utility of standard antibiotic prophylaxis, which might not be enough. Studies concerning the microorganisms of oncologic SSI are rare. Possible reasons might include difficulties to gather enough cases or the lack of interest for such a specific subject. We found only one currently ongoing prospective study on the subject, the PARITY trial (ClinicalTrials.gov NCT01479283), comparing two prophylactic cefazolin durations (1 *vs.* 5 days) but without microbiological analysis of the causative agents. According to our retrospective assessment, cefazolin or cefuroxime would fail to cover the majority of the infecting pathogens we have noted.

Conclusion

The microbiology of orthopedic SSI in adult oncologic patients is significantly different than in non-oncologic patients. The standard antibiotic prophylaxis is inadequate for the involved pathogens and the literature on this subject is lacking. Clearly, more studies are needed in order to tailor a specific perioperative prophylaxis in terms of choice of the agents, rather than of duration of the standard perioperative prophylaxis.

References

1. Peel T, May D, Buising K, Thursky K, Slavin M, Choong P. Infective complications following tumour endoprosthesis surgery for bone and soft tissue tumours. Eur J Surg Oncol. 2014;40(9):1087-94.
2. Al-Mayahi M, Cian A, Lipsky BA, Suvà D, Müller C, Landelle C, et al. Administration of antibiotic agents before intraoperative sampling in orthopedic infections alters culture results. J Infect. 2015;71(5):518-25.
3. Mavrogenis AF, Pala E, Angelini A, Calabro T, Romagnoli C, Romantini M, et al. Infected Prostheses after Lower-Extremity Bone Tumor Resection: Clinical Outcomes of 100 Patients. Surg Infect (Larchmt). 2015;16(3):267-75.
4. Angelini A, Drago G, Trovarelli G, Calabrò T, Ruggieri P. Infection after surgical resection for pelvic bone tumors: an analysis of 270 patients from one institution. Clin Orthop Relat Res. 2014;472(1):349-59.
5. 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(5):389-95.
6. Lee JA, Kim MS, Kim DH, Lim JS, Park KD, Cho WH, et al. Postoperative infection and survival in osteosarcoma patients. Ann Surg Oncol. 2009;16(1):147-51.
7. Jeys LM, Grimer RJ, Carter SR, Tillman RM, Abudu A. Post operative infection and increased survival in osteosarcoma patients: are they associated? Ann Surg Oncol. 2007;14(10):2887-95.
8. Hardes J, Gebert C, Schwappach A, Ahrens H, Streitburger A, Winkelmann W, et al. Characteristics and outcome of infections associated with tumor endoprostheses. Arch Orthop Trauma Surg. 2006;126(5):289-96.
9. Lee SH, Oh JH, Lee KS, Yoo KH, Kim HS. Infection after prosthetic reconstruction in limb salvage surgery. Int Orthop. 2002;26(3):179-84.
10. Uçkay I, Pires D, Agostinho A, Guanziroli N, Öztürk M, Bartolone P, et al. Enterococci in orthopaedic infections: Who is at risk getting infected? J Infect. 2017;75(4):309-14.
11. Jamei O, Gjoni S, Zenelaj B, Kressmann B, Belaieff W, Hannouche D, et al. Which Orthopaedic Patients Are Infected with Gram-negative Non-fermenting Rods? J Bone Jt Infect. 2017;2(2):73-6.
12. Seghrouchni K, van Delden C, Dominguez D, Benkabouche M, Bernard L, Assal M, et al. Remission after treatment of osteoarticular infections due to Pseudomonas aeruginosa versus Staphylococcus aureus: a case-controlled study. Int Orthop. 2012;36(5):1065-71.
13. Lebowitz D, Kressmann B, Gjoni S, Zenelaj B, Grosgurin O, Marti C, et al. Clinical features of anaerobic orthopaedic infections. Infect Dis (Lond). 2017;49(2):137-40.
14. Uçkay I, Harbarth S, Ferry T, Lübbeke A, Emonet S, Hoffmeyer P, et al. Meticillin resistance in orthopaedic coagulase-negative staphylococcal infections. J Hosp Infect. 2011;79(3):248-53.
15. Coppens E, Pittet D, Al-Mayahi M, Cunningham G, Holzer N, Hoffmeyer P, et al. Characteristics of Propionibacterium acnes Infections in Orthopaedic Surgery: 11 Year Study in a Referral Center, 2004-2014. Austin J Infect Dis. 2016;3(1):1021-6.