Discordant microbiology cultures from paired osteomyelitis bone specimens should question the current approach to evaluation

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Background

Current best practices management of osteomyelitis results in treatment failure in 20-30% of cases[1-3]. We question whether conventional cultures miss pathogenic organisms present in bone, thus leading to treatment failure.

Objective

The objective was to calculate the **concordance of paired operative bone cultures** (initial operation vs. reoperation) among patients who experienced foot osteomyelitis **treatment failure**.

Methods

We identified treatment failure among all cases of probable or definite osteomyelitis[4] at the Michael E. DeBakey Veterans Affairs Medical Center between 2011-2016. Treatment failure was defined as either: (1) unplanned resection of additional bone contiguous the previously treated area; or (2) leg (above-ankle) amputation.

Cases of treatment failure were included in this study if paired bone cultures were obtained – that is, bone cultures from the initial operation and at reoperation for treatment failure. Cohen's kappa was calculated to estimate concordance between isolates seen at the initial operation and reoperation. Rstudio Version 1.0.143 was used for all statistical analyses. A p-value of <0.05 was considered statistically significant.

Bone cultures are obtained from surgical bone specimens resected in the operating room after the skin of the foot is sterilized using a two-step iodine-based preparation solution. These specimens are send in a small volume of sterile saline to prevent desiccation prior to processing. Intraoperative antibiotics are typically given after surgical specimens have been obtained.

At our institution, surgical resection of grossly affected bone is followed by 2-12 weeks of antibiotic therapy selected based on bone culture results. Findings from these cultures have previously been reported[3] as 61% gram positive, 23% gram negative, 13% anaerobic, and 2% fungal. The most commonly-isolated species is *Staphylococcus aureus* (18.4% of isolates), followed by *Enterococcus species* (10.9%), streptococcal species (10.6%), and *Staphylococcus epidermidis* (5.9%).

Results

• 208 cases of definite or probable foot osteomyelitis were reviewed. Treatment failure occurred in 55 cases (26%), 35 of which had microbiology results from paired bone specimens.

•Initial cultures identified 70 bacterial and 1 fungal isolates, repeat cultures identified 77 bacterial and 3 fungal isolates.

•**Overall concordance** of organisms was **poor** (kappa = 0.180), in other words **organisms often differed** from initial treatment to reoperation for failure.

•Species and group-specific concordance ranged from poor to moderate (*Table 1*).

Table 1: Microbial isolates found in paired bone specimens from patients experiencing foot osteomyelitis treatment failure (n=35). Selected numbers in bold for emphasis on certain findings. See Results text for additional details.

organism isolated	isolated at *either* operation	present only at *initial* operation	present at *both* operations	present only at *reoperation*	absent in both	Cohen kappa	agree-ment
Staphylococcus aureus	14	4 (29%)	3 (21%)	**7 (50%)**	21	0.154	*poor*
other *Staphylococcus* spp.	9	**4 (44%)**	2 (22%)	3 (33%)	26	0.246	*fair*
Streptococcus spp.	9	**7 (78%)**	2 (22%)	0 (0)	26	0.298	*fair*
Enterococcus spp.	12	4 (33%)	**5 (42%)**	3 (25%)	23	0.457	*mod.*
Corynebacterium spp.	10	3 (30%)	**3 (30%)**	4 (40%)	25	0.340	*fair*
Pseudomonas spp.	5	1 (20%)	1 (20%)	**3 (60%)**	30	0.278	*fair*
Escherichia coli	9	4 (44%)	1 (11%)	**4 (44%)**	26	0.067	*poor*
Other gram negatives	14	7 (50%)	1 (7%)	**6 (43%)**	21	-0.102	*poor*
anaerobes	11	6 (55%)	0 (0)	**5 (45%)**	24	-0.185	*poor*
All organisms	*93*	***40 (43%)***	***18 (19%)***	***35 (38%)***	*222*	*0.180*	*poor*

•*Enterococcus* species were among the most common isolates and was the most frequent isolate to be seen at the initial operation and remain at reoperation.

•In contrast, *Staphylococcus aureus*, gram negatives, and anaerobes more frequently appeared at reoperation.

•*Streptococcus* species were rarely seen at reoperation.

Summary & Conclusions

Microbial isolates identified by conventional cultures at the time of reoperations for foot osteomyelitis treatment failure **differ frequently from those seen at the initial operation**. We hypothesize that these organisms may have been present at the initial operation.

Improving the ability to detect pathogenic organisms may be important in reducing foot osteomyelitis treatment failure rates.

These findings may also question the use of antimicrobial therapy directed by bone culture results.

References

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