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Ace Your Certification Exam: Biofilm-Based Wound Care

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Abstract Dr Jayesh Shah authors this quarterly column, consisting of 5 questions with explanations, to help you practice for your exam. In this issue, the column focuses on questions about biofilm-based wound care.

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1. All the following statements about biofilm are accurate except one. Which one is *not* accurate?
 - a. Biofilms are complex multicellular bacterial communities embedded in a matrix of extracellular polymeric substance that arise on mucosal or other exposed surfaces.
 - b. Biofilm-associated bacteria have different phenotypic characteristics and genetic expression profiles.
 - c. Biofilm leads to persistent infection and inflammation, which explains the limited effectiveness of antimicrobials in wounds.
 - d. Biofilms are a newer kind of antimicrobial dressing.
2. Antimicrobial resistance in biofilm bacteria occurs because of all of following reasons except one. Which one is *not* a reason it occurs?
 - a. Decreased penetration of antibiotics through the biofilm
 - b. Altered microbial metabolism
 - c. Decreased doubling time
 - d. Increased doubling time
3. Which method has been proven to be best in the proper diagnosis of biofilm?
 - a. Qualitative cultures
 - b. Quantitative cultures
 - c. Molecular methods
 - d. None of the above
4. Biofilm-based wound care includes which of the following?
 - a. Frequent aggressive debridement
 - b. Use of systemic antibiotics in high doses for long durations
 - c. Use of selective biocides (ionic silver, cadexomer iodine, low-dose methylene blue)
 - d. Use of combinations of antibacterial biofilm agents (doxycycline, tetracycline, gentamycin, triclosan)
 - e. All of the above
5. Debridement is considered the most important aspect of biofilm-based wound care because of which of the following?
 - a. It removes the interface of the biofilm and the host.
 - b. Any anatomy that favors biofilm development, such as undermining and tunneling, is also removed during debridement.
 - c. Debridement creates a wound environment that favors the host.
 - d. All of the above

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Answers

1, d; 2, c; 3, d; 4, e; 5, d

Question 1: Answer d

Biofilms are complex multicellular bacterial communities that arise on mucosal or other exposed surfaces.¹ These bacterial communities are embedded in a matrix of extracellular polymeric substance.¹ The chronic wound, which is a nutrient-rich environment for bacteria, furnishes a nearly perfect milieu for biofilm development.¹

Compared with planktonic bacteria typically found in culture systems, biofilm-associated bacteria have different phenotypic characteristics and genetic expression profiles.¹⁻⁴ Biofilm leads to persistent infection and inflammation, which explains the limited effectiveness of antimicrobials in wounds.¹ Biofilm-associated bacteria are thought to play a major role in chronicity of chronic wounds.¹⁻⁴ Biofilm is not a newer kind of dressing, so the correct answer is d.

Question 2: Answer c

Antimicrobial resistance in biofilm bacteria occurs because of decreased penetration of antibiotics through the biofilm, altered microbial metabolism, and increased doubling time.¹ Doubling time is especially important because the effect of all β -lactam antibiotics, and many other antimicrobials, is dependent on bacterial replication to maximize bactericidal effects.¹

Question 3: Answer d

Qualitative cultures are useful to detect planktonic bacteria that overcome the host (infection) but not in establishing the census of all organisms within the wound.¹ Quantitative culture, although considered the gold standard for studying wound microbiology, is incomplete in assessing the full spectrum of microbial agents.¹ Molecular methods such as metagenomic analysis with pyrosequencing demonstrate a high diversity of previously undetected microorganisms present within the wound.¹

Question 4: Answer e

The major strategies of biofilm-based wound care include frequent aggressive debridement, use of systemic antibiotics in high doses for long durations, use of selective biocides, and use of combinations of antibacterial biofilm agents.^{2,4} Instituting antibiotics post debridement, while the wound biofilm is reconstituting itself, makes biofilms more vulnerable to antibiotic therapy. The use of antibiotics in high doses for long durations, as is done in other biofilm-based diseases (endocarditis, osteomyelitis, etc),^{2,4} can enable more complete suppression of the biofilm. Antibiotics rarely eradicate wound biofilm, and the goal is to use antibiotics as an adjunct to suppress wound biofilm below a level that prevents healing.^{2,4}

Question 5: Answer d

Debridement is the most important aspect of biofilm based wound care. Aggressive frequent debridement, removing all adherent slough, can be accomplished through mechanical, biologic, enzymatic, or sharp debridement. Sharp debridement offers the advantage of being able to remove the interface of the biofilm and the host by removing 1 to 2 mm into viable tissue; also, removal of tunneling and undermining will create an anatomy that is more favorable to the host than to biofilm development.²

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