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IP Journal of Otorhinolaryngology and Allied Science

Journal homepage: https://www.joas.co.in/

Editorial

Biofilms in the middle ear: Unveiling challenges and solutions

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ARTICLE INFO

Article history:
Received 20-03-2024
Accepted 11-04-2024
Available online 01-05-2024

The delicate and complex structure of the middle ear makes it susceptible to various infections, especially in patients with tympanic membrane perforation. The bacteria cause both acute and chronic infections. In acute they exist as a single, independent cell (planktonic) while in chronic they get organized in colonies termed biofilms (BF). BF has sessile bacteria living in a secreted extracellular polymer matrix adherent to the surface.[1] The BF has a 3-dimensional structure with channels for nutrients, water and waste. The matrix plays an active role in controlling the local environment.[2]

Firstly, the bacteria get attached to the surface. Then with cell division and changes in gene expression, a unique biofilm phenotype is formed. There occurs production of extracellular matrix. In the last, there occurs detachment and dispersal of bacteria groups to a new environment. This process results in acute exacerbation of chronic infection.

Many human pathogens exist in BF and are responsible for chronic diseases, for example, chronic otitis media. Though the patient presents with ear discharge, the culture of the same is often reported sterile, despite the presence of bacterial DNA and RNA suggesting the presence of BF.[3]

Living in BF protects the bacteria from ultraviolet rays, osmotic and environmental changes (temperature, moisture and pH).[2]BF helps in evading natural host defenses and antimicrobial therapy, further exacerbating the disease.[4] Also, they are too large for phagocytosis. The core of BF has slowly dividing bacteria, which are more resistant to antibiotics and act as a breeding place for re-infection.[5] Because of this protective nature of biofilm, the bacteria often lead to prolonged and recurring infections. In dense BF there occurs an exchange of genetic material between bacteria, passing the favourable traits.

Addressing biofilms in ear infections requires a multifaceted approach. Breaking down the protective matrix of biofilms and targeting the embedded microorganisms is crucial. Various modalities like passing low electric current, giving radio frequency, giving pulsed ultrasound, or Furanones (found in red algae) have been shown to inhibit BF, though, in middle ear space infection, they are difficult to use. The treatment strategy found useful in my practice is the physical removal or mechanical disruption of BF. In patients with tympanic membrane perforation, suction cleaning, and flushing help in the mechanical removal of BF and controlling the disease.

BF represents a substantial but often underestimated challenge in ear infections. Their presence complicates diagnosis, exacerbates infections and contributes to treatment resistance. More research is needed before we can prevent BF formation or increase antibiotic penetration in BF to kill the bacteria.

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https://doi.org/10.18231/j.ijoas.2024.001

Conflict of Interest

None.

References

1. Costerton JW, Stewart PS, Greenberg EP. Bacterial biofilms: a common cause of persistent infections. *Science*. 1999;284(5418):1318–22.
2. Costerton JW, Lewandowski Z, Debeer D, Caldwell D, Korber D, James G, et al. Biofilms, the customized microniche. *J Bacteriol*. 1994;176(8):2137–42.
3. Rayner MG, Zhang Y, Gorry MC, Chen Y, Post JC, Ehrlich GD, et al. Evidence of bacterial metabolic activity in culture-negative otitis media with effusion. *JAMA*. 1998;279(4):296–9.
4. Stewart PS, Costerton JW. Antibiotic resistance of bacteria in biofilms. *Lancet*. 2001;358(9276):135–8.
5. Walters MC, Roe F, Bugnicourt A, Franklin MJ, Stewart PS. Contributions of antibiotic penetration, oxygen limitation, and low metabolic activity to tolerance of Pseudomonas aeruginosa biofilms to ciprofloxacin and tobramycin. *Antimicrob Agents Chemother*. 2003;47(1):317–23.

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Cite this article: Gupta M. Biofilms in the middle ear: Unveiling challenges and solutions. *IP J Otorhinolaryngol Allied Sci* 2024;7(1):1-2.