Porphyrin as Biomarker for Wound Assessment

Bacterial Fluorescence: Molecular Basis and Emerging Clinical Applications

Fluorescence is a photophysical phenomenon in which a molecule absorbs light at a specific wavelength and subsequently emits light at a longer wavelength. Many bacterial species produce fluorescent compounds endogenously, with porphyrins being the most prevalent, followed by molecules such as pyoverdine. Porphyrins are cyclic tetrapyrrole structures that play essential roles in bacterial biological functions, including oxygen transport [1]. These compounds exhibit fluorescence when excited by violet light, typically emitting a characteristic red fluorescence.

Although the photophysical basis of bacterial fluorescence has long been observed in laboratory settings [2], its translation into clinical practice is a more recent development. Fluorescence is increasingly being harnessed in the growing field of diagnostic innovation, as such in wound care [3].

Clinical Application of Bacterial Fluorescence

In wound care, fluorescence imaging has emerged as a powerful tool for real-time assessment of bacterial burden. Devices such as the MolecuLight i:X™ and Reveal® FC allow clinicians to visualize bacterial presence directly on the wound surface, guiding decisions around cleaning, debridement, and antimicrobial use, improving treatment outcomes [3, 4].

Most bacteria commonly found in wounds produce porphyrins. Given that infected wounds typically harbour polymicrobial communities, porphyrins serve as a robust and clinically relevant biomarker for bacterial colonization [5]. Empirical studies have demonstrated that fluorescence imaging can detect bacterial loads exceeding clinically significant thresholds (i.e., ≥10^4 CFU/g) [3, 5, 6], even in wounds that appear visually clean. This technology has shown particular utility in the management of chronic wounds [6].

Odinwell Sensor System: A Novel Approach to Wound Assessment

While devices such as MolecuLight i:X™ and Reveal FC are classified as point-of-care tools the Odinwell Sensor system operates on a fundamentally different principle. Rather than relying on fluorescence imaging, it utilizes spectrometric data to provide continuous, quantitative insights into the wound environment.

This approach offers several *key advantages:*

- **Miniaturized, Continuous Monitoring:** Odinwell's compact sensor technology can be integrated directly into or onto wound dressings, enabling continuous monitoring over time. As a connected device, it transmits data remotely to healthcare professionals, allowing for off-site assessment and timely intervention between clinical visits. This capability introduces new opportunities for proactive and personalized wound care.
- **Quantitative Bacterial Analysis**: Unlike imaging-based systems, Odinwell provides numerical data that can be used to quantify bacterial load, estimate growth rates, and, to some extent, infer bacterial species present. These metrics are critical for understanding wound progression and tailoring treatment strategies.
- **Data-Driven Insights:** The generation of structured, longitudinal data opens the door to advanced analytics. In the future, this could support predictive modeling, early detection of complications, and optimized treatment pathways through modeling and AI-driven decision support.

References

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