Microbe of the month

Breaking The Chain of Infection

Cutimed®

MAY 2020

Newsletter

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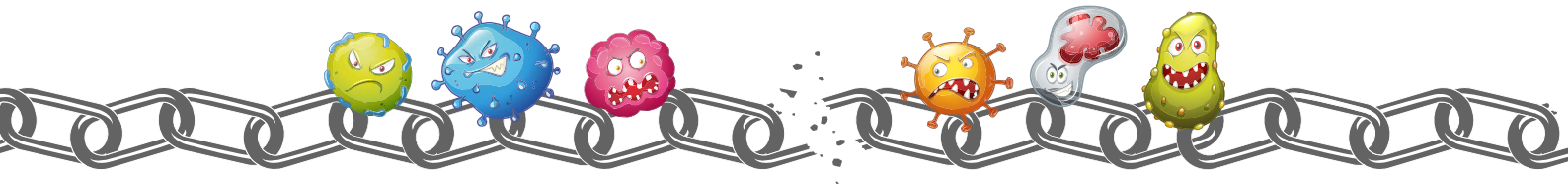

Featured this month:

Pseudomonas aeruginosa

A consummate opportunistic pathogen associated with moisture

Hello readers!

Pseudomonas aeruginosa [pronounced *Soo' doe' moan-as airoo-ginosa'*] is a Gram-negative rod-shaped bacterium which is found in soil and water – indeed, all around us in the environment, particularly where moisture is present. *Pseudomonas aeruginosa* is considered to be the kingpin of '*opportunistic pathogens*', meaning that it exploits breaks in immune defences to initiate an infection. It is the fourth most commonly isolated nosocomial pathogen, and accounts for at least 10% of all healthcare-associated infections.
It causes urinary, respiratory tract and gastrointestinal infections, dermatitis, soft tissue and wound infections, septicaemia, bone and joint infections, particularly in patients with severe burns, cancer and cystic fibrosis, and AIDS patients. *The case fatality rate in these patients is approximately 50%.*

P. aeruginosa is also a 'facultative anaerobe', which means it easily adapts to, and proliferates in, conditions of partial or total oxygen depletion. Its nutritional needs are simple, and it is tolerant to a wide variety of physical conditions, including temperature. Although viable at temperatures from 4°C - 42°C, the optimum temperature for the growth of *Pseudomonas aeruginosa* is 37°C. It is resistant to high concentrations of salts and dyes, weak antiseptics, and many commonly-used antibiotics.

Scanning electron microscopy image depicting surface 'pili' and the 'whip-like' flagellum which aids its movement in moisture-rich environments

Laboratory culture plate illustrating the characteristic slimy blue-green colonies of *Pseudomonas aeruginosa*

Wound infection with *Pseudomonas aeruginosa*

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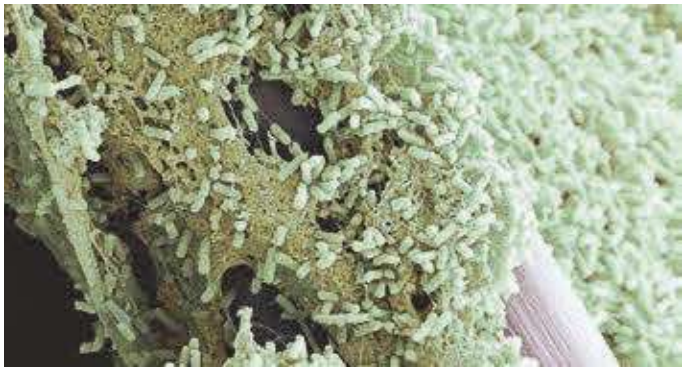
***Pseudomonas* is a large and diverse species – '*aeruginosa*' is derived from the Latin word meaning "copper rust", associated with the characteristic blue-green colour and sickly-sweet odour of *Pseudomonas* laboratory cultures from the production of the metabolite 'pyocyanin'. 'Pyo' is also a reference to pus.**

Biofilm is an important virulence strategy used by Pseudomonas aeruginosa, which facilitates the attachment of these bacteria to surfaces such as chronic wounds, plastic materials and medical devices. The 3D biofilm structure provides protection from the body's immune response, antimicrobial agents (e.g., antibiotics) and adverse environmental conditions.



Pseudomonas aeruginosa biofilm

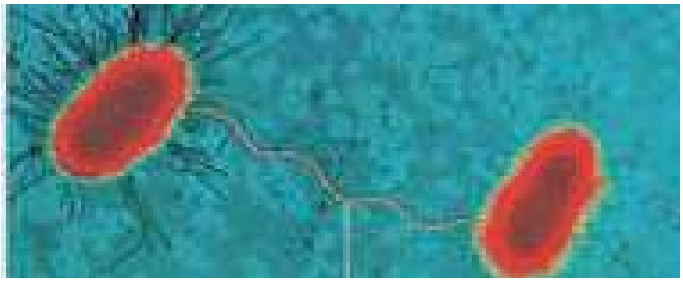
'**Quorum sensing**': This is a revolutionary discovery, whereby bacteria use a complex series of chemical signals to communicate with each other to coordinate the formation of biofilm, invasive infective processes, motility and comparative head-counts! *Pseudomonas* species in particular is known to use quorum sensing to gain a competitive advantage over other microbial species.

ANTIBIOTIC RESISTANCE

P. aeruginosa is notorious for its resistance to antibiotics and is therefore a particularly dangerous and dreaded pathogen. The bacterium is naturally resistant to many antibiotics due to the permeability barrier afforded by its Gram-negative outer membrane.

Also, its tendency to colonise surfaces in biofilm makes the *Pseudomonas* bacteria impervious to to therapeutic concentrations of antibiotics.

Since its natural habitat is the soil, living in association with many other bacilli, actinomycetes and moulds, it has developed resistance to a variety of their naturally-occurring antibiotics. Moreover, *Pseudomonas spp* maintains antibiotic resistance plasmids, and it is able to transfer these genes to other bacteria by clever mechanisms known as 'transduction' and 'conjugation' (refer to MOM April 2019 'All about Bacteria – survival at all costs').



Bacterial conjugation: two live bacteria come together – a special hair-like structure on the cell wall known as a 'sex pilus' extends from one bacterium cell and adheres to another bacterium.

At the area of contact, a channel or 'conjugation bridge' is formed, and a copy of plasmid DNA (encoding antibiotic resistance) is transferred from the donor to the recipient cell via this channel.

Clinical relevance?

Only a few antibiotics are effective against *Pseudomonas aeruginosa*, including fluoroquinolones, gentamicin and imipenem, and even these antibiotics are not effective against all strains.

The futility of treating *Pseudomonas* infections with antibiotics is most dramatically illustrated in cystic fibrosis patients, virtually all of whom eventually become infected with a strain that is so resistant that it cannot be treated.

It is estimated that 3% of carbapenem-resistant *P. aeruginosa* carry a mobile genetic element for making a carbapenemase enzyme. This enzyme makes carbapenem antibiotics ineffective.

Carbapenem resistant *Pseudomonas aeruginosa* is listed as a '**Priority 1 – Critical' pathogen** in the WHO list for research and development of new antibiotics; and a 'serious threat' by the CDC in their annual report on 'Antibiotic Resistance Threats in the United States'.[2]

What has MRSA (methicillin-resistant *Staphylococcus aureus*) got to do with *Pseudomonas*?

NATURE'S GIFT TO MEDICINE!

Mupirocin (*pseudomonic* acid A) is an antibiotic produced by *Pseudomonas fluorescens*, which has a high level of activity against staphylococci and streptococci.[3]

Notably, mupirocin is used as an intranasal antibiotic to treat patients and healthcare workers who are colonised with MRSA.

The over-the-counter availability and abuse of mupirocin (i.e., using it as a general-purpose topical antimicrobial for all types of wounds) has led to the resistance of MRSA to mupirocin, which means we now have limited options for treating life-threatening infections caused by MRSA.

Within the healthcare setting, *P. aeruginosa* finds numerous reservoirs – disinfectants, respiratory equipment, food, sinks, taps, toilets, showers and mops.

Furthermore, it is constantly reintroduced into the hospital environment on fruits, plants and vegetables, as well by visitors and patients transferred from other facilities.

This explains why fresh flowers and pot plants are prohibited in critical care units, as well as salads, nonpeelable fruits, vegetables and ice trays in haematology and transplant units. Spread occurs from patient to patient on the hands of hospital personnel, by direct patient contact with contaminated reservoirs, and by the ingestion of contaminated foods and water.

- Water sources – taps, shower heads, hand basins, hydrotherapy baths
- Bed bath basins stored wet
- Antiseptics and disinfectants decanted from bulk containers
- Liquid soap dispensers which have been 'topped up'
- Intravenous solutions contaminated by repeated access
- Humidifiers in ventilators, incubators
- Haemodialysis effluent points
- Reusable suction bottles
- Chronic wounds, especially those which produce copious exudate (e.g., deep burns and venous stasis ulcers)

The biofilm-based approach to managing *P. aeruginosa* in chronic wounds

Recognition of the presence of biofilms in chronic wounds has increased exponentially. With advances in molecular technology, biofilms are now known to have a significant negative influence in chronic wounds, so the active management of biofilms should be integral to any chronic wound treatment plan.

- **Polihexanide (polyhexamethylene biguanide or PHMB)** combined with a surfactant detergent cleanser is a non-cytotoxic antiseptic which disrupts lipoproteins in biofilm, interferes with chemical signalling ('quorum sensing') and slows biofilm regrowth.
- **Acetic acid** 1% (the active component in vinegar) is widely used to reduce the wound pH. The pH of the wound directly influences all biochemical reactions which take place during the process of healing. Research has proven that a slightly acidic pH helps to control infection and increase antimicrobial activity, oxygen release, protease activity and angiogenesis.
  In wound infection caused by *P. aeruginosa*, the growth and multiplication of this and other Gram-negative wound pathogens will induce an alkaline wound pH and promote biofilm formation – especially in the presence of high exudate levels and occlusive dressings which are not changed frequently enough.
- **Hypochlorous acid (HOCl)** exerts a microbicidal effect against a wide spectrum of bacterial, viral and fungal pathogens. Its action mimics the impact of normal neutrophil activity in the wound whereby hydrogen peroxide is produced and converted to HOCl in the presence of chlorine and hydrogen ions in the exudate.

LESSONS LEARNED FOR INFECTION PREVENTION AND CONTROL

1. **ALL microorganisms are spread by the contact route** – either directly by hands or indirectly via contact with contaminated surfaces and shared patient care equipment.

2. **Hand hygiene is the single most important measure to prevent the spread of ALL types of microbes**. **'Bare below the elbows'** –
   - Jewellery and watches get in the way of performing hand hygiene correctly.
   - Wearing rings also increases the carriage rate of Gram-negative bacteria on the hands of HCW's.
   - HCW's who wear nail polish, artificial and/or gel nails are more likely to harbour Gram-negative pathogens such as *P. aeruginosa* on their fingertips, both before and after hand washing.

3. **An alcohol-based hand sanitiser is the preferred method for cleaning your hands when they are not visibly dirty because it:**
   - is more effective at killing potentially deadly microbes on hands than soap
   - is quicker and easier to use when moving from potentially contaminated to clean areas on the same patient
   - improves safety when moving between patients or residents in shared rooms or common areas
   - improves skin condition with less irritation and dryness than soap and water

4. **Alcohol-based hand sanitisers containing between 60–80% alcohol are the most effective.**

Areas of the hand most commonly missed during hand hygiene

Hand disinfection with alcohol-based hand rub – the "fingertips first" method [5]

4. **Glove use is NOT a substitute for hand hygiene**. **Dirty gloves contaminate your hands when they are removed.** Always wash or sanitise your hands after removing gloves.

5. Critical care patients, the frail aged, diabetics, those individuals on corticosteroid therapy or with chronic respiratory and autoimmune related conditions (including burns and chronic wounds) are especially at risk of infections and sepsis caused by *Pseudomonas aeruginosa*.

6. **All infection control measures should prioritise contact transmission** with ongoing orientation, training and constant supervision of hand hygiene, the correct donning and doffing of PPE, and environmental cleaning, linen and waste management.

Tuesday 5th May 2020 is World Hand Hygiene Day!
Watch the WHO 2020 Hand Hygiene campaign video here:

https://www.youtube.com/watch?v=zCIR3J3_wEo&feature=youtu.be

Contact your local Essity representative for back copies and to sign up for the 'Microbe of the Month' mailing list

REFERENCES

1. Centers for Disease Control and Prevention (CDC) 2017. Core Infection Prevention and Control Practices for Safe Healthcare Delivery in All Settings. Recommendations of the HICPAC. Available from https://www.cdc.gov/hicpac/recommendations/core-practices.html

2. CDC (2019). Antibiotic Resistance Threats in the United States. Available from https://www.cdc.gov/drugresistance/biggest-threats.html

3. GlaxoSmithKline (2020). Package insert Bactroban Nasal Ointment 2%.

4. Nagoba, BS., Suryawanshi, NM., Wadher, B., Selkar, S. (2015). Acidic Environment and Wound Healing: A Review. Wounds;27(1):5-11.

5. SA National Dept. Health (2020). COVID1-19 Infection Control Guidelines for South Africa (Draft V1 31.3.2020). Figure 5; Page 13: Using ABHR –' fingertips first technique'.

6. Todar, K. (2020). Online Textbook of Bacteriology. Available from http://textbookofbacteriology.net/pseudomonas.html

7. World Health Organisation (2020). Save Lives – Clean Your Hands 5th May 2020. Available from https://www.who.int/infection-prevention/campaigns/clean-hands/5may2020/en/