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The Thistle QA CEU No is: **MT- 16/009**

Each attendee should claim THREE CEU points for completing this Quality Control Journal Club exercise, and retain a copy of the relevant Thistle QA Participation Certificate as proof of registration on a Thistle QA EQA.

MICROBIOLOGY LEGEND

CYCLE 39 ORGANISM 5

Proteus mirabilis

Proteus mirabilis is part of the Enterobacteriaceae family. It is a small gram-negative bacillus and a facultative anaerobe. *Proteus mirabilis* is characterized by its swarming motility, urease activity, its ability to ferment maltose and its inability to ferment lactose. *P. mirabilis* has the ability to elongate itself and secrete a polysaccharide when in contact with solid surfaces, making it extremely motile on items such as medical equipment. *Proteus mirabilis* causes 90% of all *Proteus* infections in humans and can be considered a community-acquired infection.

Proteus species are most commonly found in the human intestinal tract as part of normal human intestinal flora. It is also widely distributed in soil and water. *Proteus* is also found in multiple environmental habitats, including long-term care facilities and hospitals. In hospital settings, it is not unusual for gram-negative bacilli to colonize both the skin and oral mucosa of both patients and hospital personnel. Infection primarily occurs from these reservoirs. However, *Proteus* species are not the most common cause of nosocomial infections.

Patients with recurrent infections, those with structural abnormalities of the urinary tract, those who have had urethral instrumentation, and those whose infections were acquired in the hospital have an increased frequency of infection caused by *Proteus* and other organisms.

Diagnosis

An alkaline urine sample is a possible sign of *P. mirabilis*. It can be diagnosed in the lab due to characteristic swarming motility and inability to metabolize lactose. Also *P. mirabilis* produces a very distinct fishy odor. The flagellum of *P. mirabilis* is crucial to its motility, a characteristic that helps the organism colonize. The flagellum has also been linked to the ability of *P. mirabilis* to form biofilms, aiding in the bacteria's resistance to defences of the host and select antibiotics. *P. mirabilis* also relies on its pili for adhesion to avoid being flushed out of the urinary tract system.

Proteus mirabilis



Swarming phenomenon

swarming is described as the formation of concentric zones of bacterial growth, able to cover the whole surface of solid culture medium.



The organism tests

- Indole-negative and nitrate reductase-positive (no gas bubbles produced)
- Methyl red-positive and Voges-Proskauer negative (Can be both MR- and V-P-positive)
- Catalase positive and cytochrome oxidase-negative
- Phenylalanine deaminase-positive
- Tryptophan test-negative
- Urea test- positive
- Casein test-negative
- Starch test- negative
- Hydrogen sulfide test-positive
- Citrate agar test-negative
- Ornithine decarboxylase-positive
- Lysine decarboxylase-negative

Disease

This rod-shaped bacterium has the ability to produce high levels of urease, which hydrolyzes urea to ammonia (NH₃), so makes the urine more alkaline. If left untreated, the increased alkalinity can lead to the formation of crystals of struvite, calcium carbonate, and/or apatite, which can result in kidney stones. The bacteria can be found throughout the stones, and these bacteria lurking in the kidney stones can reinstate infection after antibiotic treatment. Once the stones develop, over time they may grow large enough to cause obstruction and renal failure. Also present are endotoxins, responsible for induction of the inflammatory response system and pore-forming haemolysins.

Sex

UTIs are the most common clinical manifestation of Proteus infections. Factors that increase infection rates include the female sex, duration of catheterization, underlying illness, faulty catheter care, and lack of systemic antibiotic therapy. Infection occurs either by migration of bacteria up the catheter along the mucosal sheath or by migration up the catheter lumen from infected urine.

Proteus infection accounts for 1%-2% of UTIs in healthy women and 5% of hospital-acquired UTIs. Complicated UTIs (i.e. those associated with catheterization) have a prevalence of 20%-45%. After age 50 years, the ratio between men and women begins to decline because of the increasing incidence of prostate disease. UTIs in men younger than 50 years are usually caused by urologic abnormalities.

Age

UTIs are more common in persons aged 20-50 years.

Treatment and Prevention

Proteus mirabilis infections can be treated with broad-spectrum penicillin's or cephalosporin's except in severe cases. It is not susceptible to nitrofurantoin or tetracycline and has experienced increasing drug resistance of ampicillin, trimethoprim, and ciprofloxin. In cases with severe stone formation, surgery is necessary to remove the blockage.

Proteus mirabilis is part of the normal flora of the gastrointestinal tract, and as a result the bacteria enters the urinary tract or infects medical equipment by the faecal route. Consequently, prevention includes good sanitation and hygiene, including proper sterilization of medical equipment. It is also suggested that patients not requiring catheterization should not receive catheterization, despite its convenience for the caretaker.

References

1. https://en.wikipedia.org/wiki/Proteus_mirabilis
2. <http://emedicine.medscape.com/article/226434-overview#showall>
3. <http://web.uconn.edu/mcbstaff/graf/Student%20presentations/Proteus/Proteus.html>
4. Images – Courtesy of google images

Questions

1. Discuss the morphological characteristics of Proteus mirabilis.
 2. Discuss the role of Proteus mirabilis in disease.
 3. Discuss the lab findings and tests used in the identification of Proteus mirabilis.
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