

# Proteus – Providencia – Morganella Group

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## Proteus-Providencia-Morganella Group

### ◆ Diseases

- Cause urinary tract infections (UTIs) — both community-acquired and nosocomial (hospital-acquired).

### ◆ Important Properties

- Belong to Enterobacteriaceae family.
- Gram-negative rods, facultative anaerobes, oxidase-negative.

### ◆ Key Biochemical Features

- Phenylalanine deaminase-positive — *differentiates them from other Enterobacteriaceae*.
- Urease-positive — hydrolyzes urea  $\rightarrow \text{NH}_3 + \text{CO}_2$ .
- Some species show high motility, especially:
  - Proteus spp.  $\rightarrow$  *produces characteristic swarming motility on blood agar (expanding concentric rings)*.

### ◆ Antigenic Properties

- O antigens of certain *Proteus* strains (OX-2, OX-19, OX-K) cross-react with rickettsial antigens.
  - Basis for Weil-Felix test:
    - Used to detect antibodies against *Rickettsiae*.
    - Now largely obsolete due to availability of more specific tests.

### ◆ Taxonomy & Nomenclature Updates

- Older names revised based on DNA relatedness:
  - *Proteus morganii* → now *Morganella morganii*
  - *Proteus rettgeri* → now *Providencia rettgeri*
- Other clinically important *Proteus* species:
  - *Proteus vulgaris*
  - *Proteus mirabilis*
- Differentiation between species via biochemical tests in the clinical lab.

### ◆ Habitat

- Found in:

- Human colon (part of normal flora)
- Soil and water

#### ◆ Pathogenesis

- UTIs often arise from:
  - Colonization of urethra (especially in women).
  - Ascending infection of urinary tract.
- Vigorous motility helps in tissue invasion.

#### ◆ Urease-Mediated Effects

- Urease hydrolyzes urea  $\rightarrow$  ammonia ( $\text{NH}_3$ )  $\rightarrow$  alkaline urine ( $\uparrow\text{pH}$ )
- Alkaline pH promotes:
  - Formation of struvite calculi (magnesium ammonium phosphate stones)
  - These stones:
    - Often form staghorn calculi in the renal pelvis.
    - Cause urine obstruction, epithelial damage, and recurrent infections.
    - Trap bacteria  $\rightarrow$  act as a nidus for chronic infection.
- Management: Maintain acidic urinary pH to:

- Inhibit stone formation
- Prevent bacterial overgrowth

## Proteus, Morganella, and Providencia Species

### ◆ Clinical Findings

- Cause urinary tract infections (UTIs) indistinguishable clinically from those caused by *E. coli* or other Enterobacteriaceae.
- Other infections:
  - Pneumonia
  - Wound infections
  - Septicemia
- *Proteus mirabilis*:
  - Most common cause of both community-acquired and hospital-acquired UTIs.
- *Proteus rettgeri*:
  - Emerging nosocomial (hospital-acquired) pathogen.

### ◆ Laboratory Diagnosis

- Highly motile organisms → show characteristic "swarming" growth on blood agar:
  - This swarming can overgrow other bacteria and hinder isolation.
  - Phenylethyl alcohol blood agar: used to inhibit swarming for better colony isolation.
- On MacConkey's or EMB agar:
  - Produce non-lactose-fermenting colonies (colorless).
- H<sub>2</sub>S Production on TSI Agar:
  - Positive (black butt): *Proteus mirabilis*, *Proteus vulgaris*
  - Negative: *Morganella morganii*, *Proteus rettgeri*
- Indole Test (important for antibiotic choice):
  - Indole-negative: *Proteus mirabilis*
  - Indole-positive: *P. vulgaris*, *M. morganii*, *P. rettgeri*
- All four species are urease-positive:
  - This leads to urine alkalization, increasing risk

of struvite stone formation.

- Identification based on biochemical tests (e.g.,  $H_2S$ , indole, urease, lactose fermentation).

#### ◆ Treatment

- General sensitivity:
  - Most strains: aminoglycosides, trimethoprim-sulfamethoxazole (TMP-SMX)
  - Perform antibiotic sensitivity testing due to variability.
- *Proteus mirabilis*:
  - Often sensitive to ampicillin
  - Indole-negative → typically more sensitive to antibiotics
- Indole-positive species (*P. vulgaris*, *M. morganii*, *P. rettgeri*):
  - More antibiotic-resistant
  - Treatment of choice: third-generation cephalosporins (e.g., cefotaxime)
- *P. rettgeri*:

- Often multi-drug resistant (MDR)

#### ◆ Prevention

- No specific vaccines or prophylaxis available.
- Key preventive measure: early removal of urinary catheters to avoid catheter-associated UTIs in hospitals.