

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 → ammonia (NH_3) → 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 → 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_2S 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 alkalinization, 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.