Acinetobacter Infections

Chapter 167 | Part 5: Infectious Diseases

KEY CLINICAL POINTS

1. A. baumannii survives environmental desiccation for weeks, facilitating hospital outbreaks.
2. Colonization vs infection differentiation is critical; airway/skin colonization does not always indicate active disease.
3. IDSA 2024 recommends sulbactam-durlobactam + carbapenem for carbapenem-resistant A. baumannii.
4. Mortality: 65% for nosocomial pneumonia, 70% for carbapenem-resistant bloodstream infections.
5. A. baumannii has intrinsic AmpC beta-lactamases (upregulated by ISAba1) and can acquire OXA-family carbapenemases.
6. Biofilm formation via exopolysaccharide/pilus production enables persistence on surfaces and medical devices.
7. High-dose ampicillin-sulbactam enhances sulbactam binding to PBPs, optimizing cell wall inhibition.
8. A. baumannii may mimic N. meningitidis on CSF Gram stain (gram-negative paired cocci).
9. Outbreaks linked to poor hand hygiene, equipment contamination, and airborne spread in unbarriered areas.
10. Sulbactam-durlobactam shows lower nephrotoxicity and improved mortality compared to colistin.

DEFINITION & CLASSIFICATION

- **Classification:** Gram-negative, oxidase-negative, nonmotile, nonfermenting coccobacilli.
- **Identification:** Phenotypic differentiation is difficult; molecular methods (MALDI-TOF-MS, PCR) are required for A. baumannii identification.
- **Persistence:** Ability to survive desiccation for weeks is critical for hospital persistence.

1.1 Historical Classification

- Originally named Micrococcus calcoaceticus (1911).
- Renamed multiple times since 1950.
- Current classification: Acinetobacter.

1.2 Morphology & Identification

- Gram-negative coccobacilli.
- Oxidase-negative, nonmotile, nonfermenting.
- Easily cultured on standard media.
- Phenotypic differentiation difficult; molecular methods (MALDI-TOF-MS, PCR) required for A. baumannii identification.

EPIDEMIOLOGY

- **Global Impact:** Rising incidence as a global nosocomial pathogen; CDC estimates 12,000 annual infections in the US (7,300 multidrug-resistant).
- **Transmission Drivers:** Outbreaks linked to ICU stays, carbapenem use, and healthcare worker hand hygiene lapses.
- **Community Cases:** Rare in temperate climates; occurs during warm/humid months (risk factors: alcohol abuse, diabetes, smoking, chronic lung disease).
- **Disaster/War Zones:** Linked to trauma victims (tsunamis, earthquakes); common infections include soft tissue injuries and bloodstream infections.

2.1 Health Care–Associated Infections

- Predominant in ICUs.
- Risk factors: Prolonged ICU stay, mechanical ventilation, central venous catheters, carbapenem exposure.
- Outbreaks reported in Ohio, Michigan, Illinois, Indiana.

2.2 Community-Acquired Infections

- Rare in temperate climates; occurs during warm/humid months.
- Risk factors: Alcohol abuse, diabetes, smoking, chronic lung disease.

2.3 Disaster & War Zone Infections

- Linked to trauma victims (tsunamis, earthquakes).
- Common infections: Soft tissue injuries, bloodstream infections, pneumonia.
- Military outbreaks linked to field hospital surfaces, not pre-injury colonization.

ETIOLOGY & PATHOPHYSIOLOGY

- **Genetics:** Pangenome includes a small core genome and large accessory genome enabling rapid adaptation.
- **Virulence Factors:**
  - Biofilm formation (exopolysaccharide/pilus).
  - Quorum sensing (abal autoinducer synthase).
  - Lipid A modification (enables desiccation survival & antibiotic resistance).
  - Extracellular capsule (complement evasion).
  - Phospholipases C/D (cytotoxicity, invasion).
  - Secretion systems (Type II/VI/V; produce lipase and toxins).
- **Resistance Mechanisms:**
  - Porin reduction.
  - Efflux pumps (quinolones, tetracyclines, tigecycline).
  - AmpC beta-lactamases (class C, upregulated by ISAba1).
  - OXA-family carbapenemases (OXA-23/51/24/40/58/143/235).

3.1 Virulence Factors

- Biofilm formation (exopolysaccharide/pilus).
- Quorum sensing (abal autoinducer synthase).
- Lipid A modification (antibiotic resistance, desiccation survival).
- Extracellular capsule (complement evasion).
- Phospholipases C/D (cytotoxicity, invasion).
- Type II/VI/V secretion systems (lipase, antibacterial toxins, biofilm adherence).

3.2 Resistance Mechanisms

- Porin reduction.
- Efflux pumps (quinolones, tetracyclines, tigecycline).
- AmpC beta-lactamases (class C, upregulated by ISAba1).
- OXA-family carbapenemases (OXA-23/51/24/40/58/143/235).

CLINICAL FEATURES

- **Pneumonia:** Nosocomial; late-onset in ventilated patients; fever, increased sputum production; 65% mortality for carbapenem-resistant strains.
- **Bloodstream Infections (BSI):** ICU-associated; fever (>95%), septic shock (25-30%), DIC; 40% mortality (70% for carbapenem-resistant); polymicrobial growth in 20-36% of cases.
- **Skin and Soft Tissue Infections (SSTI):** Common in combat trauma (gunshot wounds) and burn units; progression: edematous → sandpaper → necrotizing bullae (peau d'orange).
- **Meningitis:** Associated with outbreaks, trauma, or neurosurgery; 30% present with petechial rash; CSF Gram stain mimics N. meningitidis.

4.1 Pneumonia

- Nosocomial: Ventilated patients, late-onset.
- Symptoms: Fever, increased sputum production.
- Radiology: Lobar consolidation, pleural effusion.
- Mortality: 65% (carbapenem-resistant strains).

4.2 Bloodstream Infections

- ICU-associated (central lines/pneumonia).
- Symptoms: Fever (>95%), septic shock (25-30%), DIC.
- Mortality: 40% (70% for carbapenem-resistant).
- Polymicrobial growth: 20-36%.

4.3 Skin and Soft Tissue Infections

- Combat trauma: Gunshot wounds, orthopedic devices.
- Burn units: Delayed healing, graft loss.
- Clinical progression: Edematous → sandpaper → necrotizing bullae.

4.4 Meningitis & Other

- Outbreaks, trauma, neurosurgery.
- Petechial rash (30%).

- CSF Gram stain mimic: N. meningitidis (gram-negative paired cocci).
- Keratitis: Contact lens use.
- Endocarditis: Native/prosthetic valves.

DIFFERENTIAL DIAGNOSIS

- **Gram Stain Mimics:** N. meningitidis (appears as gram-negative paired cocci in CSF).
- **Colonization vs. Infection:** Airway, skin, or wound colonization may not indicate active disease; differentiation is critical for management.
- **Other Gram-Negatives:** Kluyvera, Raoultella (carbapenemase producers), Edwardsiella (H2S producing).

5.1 Gram Stain Mimics

- Neisseria meningitidis.
- Appearance: Gram-negative paired cocci in CSF.
- Differentiation critical for meningitis management.

5.2 Colonization vs Infection

- Airway colonization

eq pneumonia.

- Skin/wound colonization vs infection challenging to distinguish.

DIAGNOSTIC APPROACH

1. **Microbiological Identification:**
   - Culture: Easily recovered on standard media.
   - Molecular methods: MALDI-TOF-MS, PCR for A. baumannii identification due to phenotypic similarity.
   - Differentiation: H2S production (Edwardsiella) vs no H2S (Acinetobacter).
2. **Environmental Sampling:**
   - Natural reservoirs: Water, soil, fruits/vegetables.
   - Human colonization: Skin, respiratory/gastrointestinal tracts.
   - Hospital spread: Contaminated equipment (ventilators), air in unbarriered ICUs.

6.1 Microbiological Identification

- Standard culture media: Easily recovered.
- Molecular methods: MALDI-TOF-MS, PCR.
- Biochemical differentiation: H2S production (Edwardsiella) vs no H2S (Acinetobacter).

6.2 Environmental Sampling

- Natural reservoirs: Water, soil, fruits/vegetables.
- Human colonization: Skin, respiratory/gastrointestinal tracts.
- Hospital spread: Contaminated equipment, poor hand hygiene.

MANAGEMENT & TREATMENT

1. **Empirical Therapy:**
   - Recommendation (IDSA 2024): Sulbactam-durlobactam + carbapenem.
   - Consideration: Local resistance patterns and patient colonization status.
2. **Definitive Therapy:**
   - Preferred: Ampicillin-sulbactam (enhances sulbactam binding to PBPs, optimizing cell wall inhibition).
   - Alternatives: Cefepime, meropenem, or imipenem based on susceptibility testing.
3. **Carbapenem-Resistant Strains:**
   - Sulbactam-durlobactam (preferred over colistin due to lower nephrotoxicity).
   - Colistin (reserved for specific cases; preferred for urinary tract infections).
4. **Meningitis Management:**
   - High-dose ampicillin-sulbactam for CNS penetration.
5. **Specific Drug Regimens (Table 167-1):**
   - Sulbactam: 6–9 g/d (not available as single drug in many countries; different dosing if with ampicillin).
   - Sulbactam-durlobactam: 1 g/1 g q6h or 2 g q8h (infuse over 3 h).
   - Imipenem-cilastatin: 500 mg q6h or 2g q8h (carbapenem-susceptible only; infuse over 3 h).
   - Colistin: Dosing per international consensus guidelines.
   - Tigecycline: 200-mg loading dose followed by 100 mg q12h; 200 mg q12h (use in combination therapy).

7.1 Empirical Therapy

- IDSA 2024 recommendation: Sulbactam-durlobactam + carbapenem.
- Consider local resistance patterns and patient colonization status.

7.2 Definitive Therapy

- Ampicillin-sulbactam (preferred).
- Alternatives: Cefepime, meropenem, or imipenem based on susceptibility testing.

7.3 Specific Drug Classes

- Sulbactam-durlobactam: Lower nephrotoxicity vs colistin.
- Ampicillin-sulbactam: Enhances sulbactam binding to PBPs.

7.4 Infection Control (Figure 167-1)

1. **Hand Hygiene & Contact Precautions:** Primary defense against transmission via healthcare worker hands.
2. **Equipment Management:**
   - Daily and terminal disinfection.
   - Limits on shared equipment.
   - Disinfection of equipment between patients.
3. **Environmental/Patient Separation:**

- Physical separation from A. baumannii-positive patients.
- Cohorting nursing personnel.
- Chlorhexidine baths.
- Antibiotic stewardship.

PROGNOSIS & COMPLICATIONS

- **Mortality Factors:**
- High mortality linked to carbapenem/colistin resistance, delayed antimicrobial initiation, and ICU severity of illness.
- Nosocomial pneumonia: 65% mortality.
- Carbapenem-resistant BSI: 70% mortality.
- **Clinical Complications:**
- Septic shock (25-30%).
- DIC.
- Polymicrobial bacteremia (20-36%).
- Burn wound complications: Healing delays, graft loss.

8.1 Mortality Factors

- Resistance to carbapenems/colistin.
- Delayed antimicrobial initiation.
- ICU severity of illness.

8.2 Complications

- Septic shock (25-30%).
- DIC.
- Polymicrobial bacteremia.
- Burn wound complications: Healing delays, graft loss.

SPECIAL CONSIDERATIONS

- **Healthcare Settings:** Focus on infection control (hand hygiene, environmental decontamination).
- **Disaster Zones:** Trauma-associated soft tissue infections.
- **Specific Sites:**
- Burn units: High risk for graft loss and bloodstream infection.
- Meningitis: Requires CNS-penetrating antibiotics (ampicillin-sulbactam).

9.1 Health Care Settings

- Infection control: Hand hygiene, surface decontamination.
- Outbreak management: Contact precautions, cohorting.

9.2 Community & Disaster

- Disaster zones: Soft tissue infections from trauma.
- Military outbreaks: Field hospital acquisition, not pre-injury colonization.

9.3 Specific Sites

- Burn units: High risk for graft loss and bloodstream infection.
- Meningitis: Requires CNS-penetrating antibiotics (ampicillin-sulbactam).

KEY PEARLS & CLINICAL TRAPS

- **Gram Stain Trap:** A. baumannii mimics N. meningitidis (gram-negative paired cocci) in CSF.
- **Colonization Rule:** Airway/skin colonization

eq infection; do not treat unless clinical evidence of disease exists.

- **Persistence:** Biofilm formation via exopolysaccharide/pilus allows survival on surfaces.
- **Treatment Choice:** Sulbactam-durlobactam is preferred over colistin due to lower nephrotoxicity.
- **Mortality Alert:** Mortality exceeds 65% for nosocomial pneumonia and 70% for carbapenem-resistant BSI.

REFERENCE TABLES

TABLE 167-1

Therapeutic Options for the Management of Multidrug- Resistant Acinetobacter baumannii Infections ANTIBIOTIC Sulbactam

ANTIBIOTIC	DOSINGa	COMMENTS
Sulbactam	6–9 g/d	Unavailable as single drug in many countries (including the United States). Different dosing strategies proposed if administered with ampicillin.
	3 g q4h 9 g q8h 27 g q24h	
Sulbactam-durlobactam	1 g/1 g q6h	Infuse over 3 h
	2 g q8h	
Imipenem-cilastatin	500 mg q6h	Carbapenem-susceptible isolates only; infuse over 3 h
	2g q8h	
Colistin	Dosing per the international consensus guidelines on polymixins (Tsuji BT et al, Pharmacotherapy 39:10, 2019)	Colistin is preferred for urinary tract infections.
	Dosing per the international consensus guidelines on polymixins (Tsuji BT et al, Pharmacotherapy 39:10, 2019)	

ANTIBIOTIC	DOSINGa	COMMENTS
Tigecycline	200-mg loading dose followed by 100 mg q12h	Use in combination therapy
	200 mg q12h	
Shared e	quipment	
-Daily and terminal disinfection		
-Limits on shared equipment -Disinfection of equipment between patients		