Acinetobacter

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**Synonyms and related keywords:** *Acinetobacter baumannii*, *A baumannii*, *Acinetobacter lwoffi*, *A lwoffi*, *Acinetobacter pneumonia*, *Mima polymorpha*, nosocomial pneumonia, continuous ambulatory peritoneal dialysis, CAPD, catheter-associated bacteruria, *Acinetobacter* urinary tract infection, UTI, URTI

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Background: *Acinetobacter baumannii* is a pleomorphic aerobic gram-negative bacillus (similar in appearance to *Haemophilus influenzae* on Gram stain) commonly isolated from the hospital environment and hospitalized patients. A *baumannii* is a water organism and preferentially colonizes aquatic environments. This organism is often cultured from hospitalized patients’ sputum or respiratory secretions, wounds, and urine. *Acinetobacter* also colonizes irrigating solutions and intravenous solutions.

*Acinetobacter* is an organism of low virulence, but it is capable of causing infection. Most *Acinetobacter* isolates recovered from hospitalized patients, particularly those recovered from respiratory secretions and urine, represent colonization rather than infection.

*Acinetobacter* infections are uncommon, but, when they occur, they usually involve organ systems with a high fluid content (eg, respiratory tract, peritoneal fluid, urinary tract), manifesting as nosocomial pneumonia, infections associated with continuous ambulatory peritoneal dialysis (CAPD), or catheter-associated bacteruria. The presence of the organism in respiratory secretions in intubated patients nearly always represents colonization. *Acinetobacter* pneumonias occur as outbreaks and are usually associated with colonized respiratory support equipment or fluids.

*A baumannii* is a multiresistant aerobic gram-negative bacillus sensitive to relatively few antibiotics. Multidrug-resistant *Acinetobacter* is not a new or emerging phenomenon, but *A baumannii* has always been an organism inherently resistant to multiple antibiotics.

Pathophysiology: In the uncommon situations in which *Acinetobacter* causes actual infection, the pathological changes that occur depend on the organ system involved. The pathological changes, as observed in patients with pneumonia, are indistinguishable from those caused by other noncavitating aerobic gram-negative bacilli that cause nosocomial pneumonias. Similarly, *Acinetobacter* urinary tract infections are clinically indistinguishable from catheter-associated bacteremias caused by other aerobic gram-negative bacilli.
Frequency:

- **Internationally**: *Acinetobacter* is a common colonizer of patients in the intensive care setting. *Acinetobacter* colonization is particularly common in patients who are intubated and in those who have multiple intravenous lines or monitoring devices, surgical drains, or indwelling urinary catheters. *Acinetobacter* infections are rare and occur almost exclusively in hospitalized patients.

Mortality/Morbidity:

- Although *Acinetobacter* primarily is a colonizer in the hospital environment, occasionally it causes infection. Mortality and morbidity resulting from *A. baumannii* infection relate to the underlying cardiopulmonary immune status of the host rather than the inherent virulence of the organism.

- Patients who are very ill with multisystem disease have increased mortality and morbidity rates resulting from their underlying illness rather than the superimposed infection with *Acinetobacter*.

Race: No racial predilection is known.

Sex: No sex predilection is known.

Age: No age predilection exists.

History:

- No particular features in a patient's history suggest *Acinetobacter* colonization.

- Patients with *Acinetobacter* pneumonias occurring in the context of an outbreak in the intensive care unit (ICU) generally have a history of preceding contact with respiratory support monitors or equipment.

- Patients with *Acinetobacter* colonization often have a history of prolonged hospitalization, ICU exposure, or previous antimicrobial therapy (with
antibiotics that have little or no activity against

*Acinetobacter*).

**Physical:**

- Because colonization is the rule and infection is the exception, physical findings are not present in colonized patients.

- Patients with actual infection with *Acinetobacter* have signs and symptoms related to the organ system involved, ie, wound infection, episodic outbreaks of nosocomial pneumonia, CAPD-associated peritonitis, or catheter-associated bacteruria.

- The following is summarized from an article by Go and Cunha (1999):
  
  - *Acinetobacter* commonly colonizes skin, oropharynx secretions, respiratory secretions, and urine.
  
  - *Acinetobacter* uncommonly colonizes the gastrointestinal tract and is associated with nosocomial pneumonias (which usually occur as outbreaks), bacteremias, and wound infections.
  
  - *Acinetobacter* infection is rarely associated with meningitis, endocarditis (native infective endocarditis and prosthetic valve endocarditis), peritonitis, urinary tract infections, community-acquired pneumonia, and cholangitis.

**Causes:**

- Antimicrobial therapy using agents with little or no activity against *Acinetobacter* predisposes to *Acinetobacter* colonization.

- Residency in an ICU, particularly in the presence of other patients who are colonized with *Acinetobacter*, predisposes patients to colonization by this organism.
Other Problems to be Considered:

The main differential diagnostic problem with *Acinetobacter* is to differentiate colonization from infection.

In the presence of nosocomial pneumonias, CAPD-associated peritonitis, meningitis, wound infection, or catheter-associated bacteruria, the differential diagnosis includes other aerobic gram-negative bacilli that colonize or infect these fluids, ie, *Enterobacter* species, *Stenotrophomonas maltophilia*, *Burkholderia cepacia*, *Pseudomonas aeruginosa*, *Flavobacterium meningosepticum*, and *Serratia marcescens*.

Because *Acinetobacter* predominantly is a colonizing organism, the burden of proof is on the clinician to demonstrate its pathogenic role in a given situation.

Lab Studies:

- A complete blood cell (CBC) count is nonspecific, and leukocytosis, even with a left shift, cannot be used to differentiate infection from noninfection or bacterial infection from nonbacterial infection. The CBC count cannot be used to differentiate infection from colonization.

- Culture of the appropriate body fluid that is properly transported, plated, and incubated grows *A baumannii*.

- Recovery of the organism from a nonsterile body site (eg, endotracheal secretions, urine in patient with Foley catheter) does not indicate anything other than its presence and does not imply a pathogenic role.

- If the presence of *Acinetobacter* is suspected, it may be readily cultured from cerebrospinal fluid (CSF), blood, respiratory secretions, peritoneal fluid, wound exudate, or urine.

- In outbreaks, *Acinetobacter* may be easily cultured from monitoring devices or biological fluids as part of an epidemiological investigation.

Imaging Studies:
A CT scan may be necessary to rule out parameningeal processes.

A chest radiograph and/or CT scan or MRI of the chest may be useful in defining the extent of a nosocomial pneumonia caused by any organism.

Other Tests:

- Tests are related to the organ system involved.

Procedures:

- A lumbar puncture is necessary if shunt-associated meningitis is suspected.

Histologic Findings: Histological changes caused by *Acinetobacter* infection are indistinguishable from those caused by all aerobic gram-negative bacilli, except those associated with vessel invasion and cavitation, eg, *Klebsiella pneumoniae* and *P. aeruginosa*.

**Medical Care:** Initiate supportive care, depending on the organ system involved.

**Surgical Care:** Colonized or infected lines, drains, shunts, or other devices should be removed or replaced as required.

**Consultations:** A consultation with an infectious disease specialist is advised to differentiate colonization from infection and for antibiotic recommendations if infection is present.

*A. baumannii* is naturally multidrug resistant. Relatively few antibiotics are active against this organism. While colonization should not be treated, infection should.

The following usual *Acinetobacter* antibiotic susceptibilities are summarized by Go and Cunha (1999):

- Medications to which *Acinetobacter* is highly sensitive include the following:
  - Meropenem
  - Imipenem (associated with the rapid development of resistance)
  - Polymyxin B
- Piperacillin/tazobactam
- Most third-generation cephalosporins
- Amikacin
- Cefepime
- Ciprofloxacin (associated with the rapid development of resistance)
- Levofloxacin
- Medications to which *Acinetobacter* is moderately sensitive include the following:
  - Ceftazidime
  - Tobramycin
  - The following medications have little and/or no activity against *Acinetobacter*
    - Penicillins
    - Most antipseudomonal penicillins
    - First- and second-generation cephalosporins
    - Gentamicin
    - Aztreonam
    - Chloramphenicol

The antibiotics that usually are effective against *A. baumannii* infections include imipenem, meropenem, cefepime, polymyxin B, and piperacillin and tazobactam. Other antibiotics occasionally are useful (eg, trimethoprim-sulfamethoxazole [TMP-SMX], fluoroquinolones).

In general, first-, second-, and third-generation cephalosporins, tetracyclines, macrolides, and penicillins have little or no anti-*Acinetobacter* activity, and their use may predispose to *Acinetobacter* colonization.

**Drug Category: Antibiotics** -- Empiric antimicrobial therapy must be comprehensive and should cover all likely pathogens in the context of the clinical setting.

<table>
<thead>
<tr>
<th>Drug Name</th>
<th>Imipenem and cilastatin (Primaxin) -- For treatment of multiple-organism infections in which other agents do not have broad-spectrum coverage or are contraindicated because of potential for toxicity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult Dose</td>
<td>0.5-1 g IV q6h</td>
</tr>
<tr>
<td>Pediatric Dose</td>
<td>&lt;12 years: Not established; suggested dose is 15-25 mg/kg per dose IV q6h</td>
</tr>
<tr>
<td>Contraindications</td>
<td>Documented hypersensitivity</td>
</tr>
<tr>
<td>Interactions</td>
<td>Coadministration with cyclosporine may increase adverse CNS effects of both agents; coadministration with ganciclovir may result in generalized seizures</td>
</tr>
<tr>
<td>Drug Name</td>
<td>Pregnancy</td>
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</tr>
<tr>
<td>Meropenem (Merrem)</td>
<td>C - Safety for use during pregnancy has not been established.</td>
</tr>
<tr>
<td>Cefepime (Maxipime)</td>
<td>B - Usually safe but benefits must outweigh the risks.</td>
</tr>
<tr>
<td>Polymyxin B (Polytrim)</td>
<td>B - Usually safe but benefits must outweigh the risks.</td>
</tr>
</tbody>
</table>

**Meropenem (Merrem)** -- Bactericidal broad-spectrum carbapenem antibiotic that inhibits cell wall synthesis. Effective against most gram-positive and gram-negative bacteria. Has slightly increased activity against gram-negative bacteria and slightly decreased activity against staphylococci and streptococci compared to imipenem.

**Cefepime (Maxipime)** -- Fourth-generation cephalosporin with good gram-negative coverage, similar to ceftazidime but has better gram-positive coverage.

**Polymyxin B (Polytrim)** -- Used to treat ocular infections involving cornea or conjunctiva that result from strains of...
<table>
<thead>
<tr>
<th><strong>Drug Name</strong></th>
<th>Piperacillin and tazobactam (Zosyn) -- Antipseudomonal penicillin plus beta-lactamase inhibitor. Inhibits biosynthesis of cell wall mucopeptide and is effective during stage of active multiplication. Tazobactam increases piperacillin activity against <em>Staphylococcus aureus</em> and <em>Klebsiella, Enterobacter</em>, and <em>Serratia</em> species (greatest increase in activity against <em>Bacteroides fragilis</em>), but does not increase anti-<em>P aeruginosa</em> activity.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adult Dose</strong></td>
<td>Up to 4.5 g IV q8h (piperacillin 4 g and tazobactam 0.5 g)</td>
</tr>
<tr>
<td><strong>Pediatric Dose</strong></td>
<td>&gt;10 years: Administer as in adults &lt;10 years: Not established</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Documented hypersensitivity; severe pneumonia; bacteremia; pericarditis; emphysema; meningitis; purulent or septic arthritis</td>
</tr>
<tr>
<td><strong>Interactions</strong></td>
<td>Probenecid increases piperacillin serum levels; synergistic effect with aminoglycosides; heparin increases risk of bleeding; may decrease</td>
</tr>
<tr>
<td><strong>Adult Dose</strong></td>
<td>Solution: Instill 1-2 gtt q2h in affected eye while awake Ointment: Apply 0.5-in ribbon into conjunctival sac qid and/or at hs</td>
</tr>
<tr>
<td><strong>Pediatric Dose</strong></td>
<td>&lt;2 years: Not established &gt;2 years: Administer as in adults</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Documented hypersensitivity; viral or mycobacterial eye infections; fungal disease</td>
</tr>
<tr>
<td><strong>Interactions</strong></td>
<td>None reported</td>
</tr>
<tr>
<td><strong>Pregnancy</strong></td>
<td>B - Usually safe but benefits must outweigh the risks.</td>
</tr>
<tr>
<td><strong>Precautions</strong></td>
<td>Do not use for deep ocular infections or for those that are likely to become systemic; prolonged use of antibiotics or repeated therapy may result in bacterial or fungal overgrowth of nonsusceptible organisms</td>
</tr>
<tr>
<td>Precautions</td>
<td>Performance of CBC counts prior to initiation of therapy and at least weekly during therapy; monitor for liver function abnormalities by measuring AST and ALT during therapy; use caution in patients diagnosed with hepatic insufficiencies; perform urinalysis and BUN and creatinine determinations during therapy and adjust dose if values become elevated; monitor blood levels to avoid possible neurotoxic reactions</td>
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**FOLLOW-UP**

**Further Inpatient Care:**

- Precautions should be taken to prevent colonized patients from colonizing other patients, particularly in the ICU.

**Deterrence/Prevention:**

- Although colonization rarely results in infection, colonization does precede infection. Colonization in one patient may result in infection in another patient. For these reasons, every attempt should be made to isolate patients who are colonized with *Acinetobacter* in order to prevent other patients from becoming colonized.

**Prognosis:**

- Prognosis depends on the underlying health of the host and the extent of organ involvement; it is the same as for other aerobic gram-negative bacillary infections.

**Medical/Legal Pitfalls:**

- Clinicians should be careful not to use potentially toxic drugs to treat *A. baumannii* colonization because colonization does not present a threat to
A patient may develop an adverse effect from a medication that was needlessly prescribed to treat colonization, and this must be considered when deciding to embark on therapy and when selecting particular antimicrobials.

BIBLIOGRAPHY

- Gehrlein M, Leyer H, Cullmann W: Imipenem resistance in Acinetobacter baumanii is due to altered penicillin-binding proteins.
• Irwin RS, Demers RR, Pratter MR: An outbreak of Acinetobacter infection associated with the use of a ventilator spirometer. Respir Care 1980 Feb; 25(2): 232-7[Medline].
• Peacock JE, Sorrell L, Sottille FD: Nosocomial respiratory tract colonization and infection with aminoglycoside-resistant Acinetobacter calcoaceticus var anitratus: epidemiologic characteristics and clinical significance. Infect Control Hosp Epidemiol 1988 Jul; 9(7): 302-


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