Antimicrobial Prophylaxis for Surgery

Antimicrobial prophylaxis can decrease the incidence of infection, particularly surgical site infection, after certain procedures. Recommendations for prevention of surgical site infection are listed in the table that begins on page 48. Antimicrobial prophylaxis for dental procedures to prevent endocarditis is discussed in The Medical Letter 2007; 49:99.

CHOICE OF A PROPHYLACTIC AGENT

An effective prophylactic regimen should be directed against the most likely infecting organisms, but need not eradicate every potential pathogen. For most procedures, the first-generation cephalosporin cefazolin (Ancef, and others), which is active against many staphylococci and streptococci, remains effective. For procedures that might involve exposure to bowel anaerobes, including Bacteroides fragilis, the second-generation cephalosporins cefoxitin (Mefoxin, and others) and cefotetan are more active than cefazolin against these organisms. Cefazolin plus metronidazole (Flagyl, and others), or ampicillin/sulbactam (Unasyn, and others) alone, are reasonable alternatives.1 Cefuroxime (Zinacef, and others) is a second-generation cephalosporin with little activity against B. fragilis, but it can be used instead of cefazolin in non-cardiac thoracic or orthopedic operations. In institutions where surgical site infections are frequently due to methicillin-resistant Staphylococcus aureus (MRSA) or methicillin-resistant coagulase-negative staphylococci, vancomycin (Vancocin, and others) can be used for prophylaxis, but it may not be more effective than cefazolin in these settings and such use could lead to emergence of vancomycin-resistant organisms.2

Screening for MRSA – Pre-operative identification of patients colonized with MRSA and subsequent decolonization using intranasal mupirocin (Bactroban, and others) remains controversial.3,4 Intranasal mupirocin has been shown to decrease the rate of post-operative infections with MRSA in some patients who were colonized before surgery.5,6 The Society of Thoracic Surgeons recommends decolonization with mupirocin prior to cardiac surgery for all patients without documented negative testing (via nasopharyngeal swab and culture or PCR) for MRSA.7 Decontamination with an oral formulation of chlorhexidine gluconate (Peridex, and others) has also been tried with some success.8,9 However, other studies using chlorhexidine bathing have not found any impact on surgical site infection.10,11

TIMING AND NUMBER OF DOSES

It has been common practice to give antibiotics at the time of anesthesia induction, which results in adequate serum and tissue levels. For procedures lasting less than 4 hours, Medical Letter consultants recommend a single intravenous dose of an antimicrobial started within 60 minutes before the initial skin incision. If vancomycin or a fluoroquinolone is used, the infusion should begin 60-120 minutes before the incision to minimize the risk of antibiotic-associated reactions around the time of anesthesia induction and to ensure adequate tissue levels of the drug at the time of the initial incision.

Additional Doses – Published studies of antimicrobial prophylaxis often use one or two doses postoperatively in addition to one dose just before surgery; most Medical Letter consultants believe that postoperative doses are usually unnecessary and can increase the risk of antimicrobial resistance.

INDICATIONS

Cardiac Surgery – Preoperative antibiotics can decrease the incidence of infection after cardiac surgery, and intraoperative redosing has been associated with a decreased risk of postoperative infection in pro-
Antimicrobial prophylaxis for surgery

**Table 1. Antimicrobial Prophylaxis for Surgery**

<table>
<thead>
<tr>
<th>Nature of Operation</th>
<th>Common Pathogens</th>
<th>Recommended Antimicrobials</th>
<th>Adult Dosage Before Surgery¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cardiac</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staphylococcus aureus, S. epidermidis</td>
<td>Cefazolin OR vancomycin³</td>
<td>1-2 g IV²</td>
<td>1 g IV</td>
</tr>
<tr>
<td><strong>Gastrointestinal</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Esophageal, gastroduodenal</td>
<td>Enteric gram-negative bacilli, gram-positive cocci</td>
<td><strong>High risk</strong>: only: cefazolin⁵</td>
<td>1-2 g IV</td>
</tr>
<tr>
<td>Biliary tract</td>
<td>Enteric gram-negative bacilli, enterococci, clostridia</td>
<td><strong>High risk</strong>: only: cefazolin⁵</td>
<td>1-2 g IV</td>
</tr>
<tr>
<td>Colorectal</td>
<td>Enteric gram-negative bacilli, anaerobes, enterococci</td>
<td>Oral: neomycin + erythromycin base⁷ OR + metronidazole⁷ Parenteral: cefoxitin⁸ or cefotetan⁹</td>
<td>1-2 g IV</td>
</tr>
<tr>
<td>Appendectomy, non-perforated⁸</td>
<td>Same as for colorectal</td>
<td>Cefoxitin⁸ or cefotetan⁹</td>
<td>1-2 g IV</td>
</tr>
<tr>
<td><strong>Genitourinary</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cystoscopy alone</td>
<td>Enteric gram-negative bacilli, enterococci</td>
<td><strong>High risk</strong>: only: ciprofloxacin OR trimethoprim-sulfamethoxazole</td>
<td>500 mg PO or 400 mg IV</td>
</tr>
<tr>
<td>Cystoscopy with manipulation or Upper tract instrumentation¹⁰</td>
<td>Enteric gram-negative bacilli, enterococci</td>
<td>Ciprofloxacin</td>
<td>500 mg PO or 400 mg IV</td>
</tr>
<tr>
<td>Open or laparoscopic surgery¹¹</td>
<td>Enteric gram-negative bacilli, enterococci</td>
<td>Ciprofloxacin OR trimethoprim-sulfamethoxazole</td>
<td>1 DS tablet</td>
</tr>
</tbody>
</table>

1. Parenteral prophylactic antimicrobials can be given as a single IV dose begun 60 minutes or less before the operation. For prolonged operations (>4 hours), or those with major blood loss, additional intraoperative doses should be given at intervals 1-2 times the half-life of the drug (ampicillin/sulbactam q2-4 hours, cefazolin q2-5 hours, cefuroxime q3-4 hours, cefotaxime q2-3 hours, clindamycin q3-6 hours, vancomycin q6-12 hours, and metronidazole q6-8 hours [DW Bratzler et al. Clin Infect Dis 2004; 38:1706]) for the duration of the procedure in patients with normal renal function. If vancomycin or a fluoroquinolone is used, the infusion should be started 60-120 minutes before the initial incision in order to minimize the possibility of an infusion reaction close to the time of induction of anesthesia and to have adequate tissue levels at the time of incision.

2. Some consultants recommend an additional dose when patients are removed from bypass during open-heart surgery.

3. Vancomycin can be used in hospitals in which methicillin-resistant *S. aureus* and *S. epidermidis* are a frequent cause of postoperative wound infection, patients previously colonized with MRSA, or for those who are allergic to penicillins or cephalosporins. Rapid IV administration may cause hypotension, which could be especially dangerous during induction of anesthesia. Even when the drug is given over 60 minutes, hypotension may occur; treatment with diphenhydramine (Benadryl, and others) and further slowing of the infusion rate may be helpful. Some experts would give 15 mg/kg of vancomycin to patients weighing more than 75 kg, up to a maximum of 1.5 g, with a slower infusion rate (90 minutes for 1.5 g). For operations in which enteric gram-negative bacilli are common pathogens, many Medical Letter consultants would add another drug such as an aminoglycoside (gentamicin, tobramycin or amikacin).

4. Morbid obesity, esophageal obstruction, decreased gastric acidity or gastrointestinal motility.

5. For patients allergic to penicillins and cephalosporins, clindamycin with either gentamicin, ciprofloxacin, levofloxacin or aztreonam is a reasonable alternative.

6. Age >70 years, acute cholecystitis, non-functioning gall bladder, obstructive jaundice or common duct stones.

7. 1 g of neomycin plus 1 g of erythromycin at 1 PM, 2 PM and 11 PM or 2 g of neomycin plus 2 g of metronidazole at 7 PM and 11 PM the day before an 8 AM operation.

Antimicrobial prophylaxis for prevention of device-related infections has not been rigorously studied, but is generally used before placement of electrophysiologic devices, ventricular assist devices, ventriculoatrial shunts and arterial patches. Studies of antimicrobial prophylaxis for implantation of permanent pacemakers and cardioverter-defibrillators have shown a significant reduction in the incidence of wound infection, inflammation and skin erosion.

Gastrointestinal Surgery – Antimicrobial prophylaxis is recommended for esophageal surgery in the presence of obstruction, which increases the risk of infection. After gastroduodenal surgery, the risk of infection is high when gastric acidity and gastrointestinal motility are diminished by obstruction, hemorrhage, gastric ulcer or malignancy, or by therapy with an H₂-
blocker or proton pump inhibitor, and is also high in patients with morbid obesity. One dose of cefazolin before surgery can decrease the incidence of postoperative infection in these circumstances. Prophylaxis is not indicated for routine gastroesophageal endoscopy, but most clinicians use it before placement of a percutaneous gastrostomy.

Preoperative antibiotics are used routinely for bariatric surgery, including adjustable gastric banding, vertical banded gastroplasty, Roux-en-y bypass and bilio-pancreatic diversion, but no controlled trials supporting such use are available.

Antimicrobial prophylaxis is recommended before biliary tract surgery for patients with a high risk of infection, such as those more than 70 years old and those with acute cholecystitis, a non-functioning gallbladder, obstructive jaundice or common duct stones. Similar guidelines apply to antibiotic prophylaxis of endoscopic retrograde cholangiopancreatography (ERCP). Prophylactic antibiotics are generally not necessary for low-risk patients undergoing elective laparoscopic cholecystectomy.

Preoperative antibiotics can decrease the incidence of infection after colorectal surgery; for elective opera-

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**Table 1. Antimicrobial Prophylaxis for Surgery (cont’d)**

<table>
<thead>
<tr>
<th>Nature of Operation</th>
<th>Common Pathogens</th>
<th>Recommended Antimicrobials</th>
<th>Adult Dosage Before Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gynecologic and Obstetric</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaginal, abdominal or laparoscopic hysterectomy</td>
<td>Enteric gram-negative bacilli, anaerobes, Gp B strep, enterococci</td>
<td>Cefoxitin®, cefotetan® or cefazolin® OR ampicillin/sulbactam®</td>
<td>1-2 g IV 3 g IV</td>
</tr>
<tr>
<td>Cesarean section</td>
<td>same as for hysterectomy</td>
<td>Cefazolin®</td>
<td>1-2 g IV</td>
</tr>
<tr>
<td>Abortion</td>
<td>same as for hysterectomy</td>
<td>Doxycycline</td>
<td>300 mg PO®</td>
</tr>
<tr>
<td><strong>Head and Neck Surgery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incisions through oral or pharyngeal mucosa</td>
<td>Anaerobes, enteric gram-negative bacilli, S. aureus</td>
<td>Clindamycin OR cefazolin + metronidazole</td>
<td>600-900 mg IV 1-2 g IV 0.5 g IV</td>
</tr>
<tr>
<td><strong>Neurosurgery</strong></td>
<td>S. aureus, S. epidermidis</td>
<td>Cefazolin OR vancomycin®</td>
<td>1-2 g IV 1 g IV</td>
</tr>
<tr>
<td><strong>Ophthalmic</strong></td>
<td>S. epidermidis, S. aureus, streptococci, enteric gram-negative bacilli, <em>Pseudomonas spp.</em></td>
<td>Gentamicin, tobramycin, ciprofloxacin, gatifloxacin levofloxacin, moxifloxacin, ofloxacin or neomycin-gramicidin-polymyxin B cefazolin</td>
<td>Multiple drops topically over 2 to 24 hours</td>
</tr>
<tr>
<td><strong>Orthopedic</strong></td>
<td>S. aureus, S. epidermidis</td>
<td>Cefazolin® OR vancomycin® OR cefuroxime® OR ceftaxime OR cefuroxime</td>
<td>1-2 g IV 1.5 g IV 1 g IV</td>
</tr>
<tr>
<td><strong>Thoracic (Non-Cardiac)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S. aureus, S. epidermidis, streptococci, enteric gram-negative bacilli</td>
<td>Cefazolin or cefuroxime OR vancomycin®</td>
<td>1-2 g IV 1.5 g IV 1 g IV</td>
<td></td>
</tr>
<tr>
<td><strong>Vascular</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arterial surgery involving a prosthesis, the abdominal aorta, or a groin incision</td>
<td>S. aureus, S. epidermidis, enteric gram-negative bacilli</td>
<td>Cefazolin OR vancomycin®</td>
<td>1-2 g IV 1 g IV</td>
</tr>
<tr>
<td>Lower extremity amputation for ischemia</td>
<td>S. aureus, S. epidermidis, enteric gram-negative bacilli, clostridia</td>
<td>Cefazolin OR vancomycin®</td>
<td>1-2 g IV 1 g IV</td>
</tr>
</tbody>
</table>

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8. For a ruptured viscus, therapy is often continued for about five days.
9. Urine culture positive or unavailable, preoperative catheter, transrectal prostatic biopsy, placement of prosthetic material.
10. Shockwave lithotripsy, ureteroscopy.
11. Including percutaneous renal surgery, procedures with entry into the urinary tract, and those involving implantation of a prosthesis. If manipulation of bowel is involved prophylaxis is given according to colorectal guidelines.
12. Divided into 100 mg one hour before the abortion and 200 mg one half hour after.
13. If a tourniquet is to be used in the procedure, the entire dose of antibiotic must be infused prior to its inflation.
Antimicrobial Prophylaxis for Surgery

Antimicrobial prophylaxis decreases the incidence of postoperative bacteriuria and septicemia in patients with sterile preoperative urine undergoing transurethral prostatectomy and transrectal prostatic biopsies. Prophylaxis is also used for ureteroscopy, shock wave lithotripsy, percutaneous renal surgery, open laparoscopic procedures, and when a urologic prosthesis (penile implant, artificial sphincter, synthetic pubovaginal sling, bone anchors for pelvic floor reconstruction) will be placed. Antimicrobial prophylaxis in patients undergoing open reduction or internal fixation of mandibular fractures.

Neurosurgery – An antistaphylococcal antibiotic can decrease the incidence of infection after craniotomy. In spinal surgery, the infection rate after conventional lumbar discectomy is low, but the serious consequences of a surgical site infection have led many surgeons to use perioperative antibiotics. One meta-analysis concluded that antibiotic prophylaxis prevents infection even in low-risk spinal surgery. Infection rates are higher after prolonged spinal surgery or spinal procedures involving fusion or insertion of foreign material, and prophylactic antibiotics are generally used. Some studies of antimicrobial prophylaxis for implantation of permanent cerebrospinal fluid shunts have shown lower infection rates with use of prophylactic antibiotics; the benefits of antimicrobial prophylaxis for ventriculostomy placement remains uncertain.

Ophthalmic Surgery – Data are limited on the effectiveness of antimicrobial prophylaxis for ophthalmic surgery, but most ophthalmologists use antimicrobial eye drops for prophylaxis, and some also give a subconjunctival injection of an antimicrobial or add antimicrobial drops to the intraocular irrigation solution. There is no consensus supporting a particular choice, route or duration of antimicrobial prophylaxis. Preoperative povidone-iodine applied to the skin and conjunctiva has been associated with a lower incidence of culture-proven endophthalmitis. There is no evidence that prophylactic antibiotics are needed for procedures that do not invade the globe.

Orthopedic Surgery – Prophylactic antistaphylococcal drugs administered preoperatively can decrease the incidence of both early and delayed infection following joint replacement and after surgical repair of closed fractures. They also decrease the rate of infection when hip and other closed fractures are treated with internal fixation by nails, plates, screws or wires, and in compound or open fractures. Whether single-dose or 24-hour prophylactic use of antibiotics is superior is unclear. A retrospective review of patients undergoing diagnostic and operative arthroscopic surgery concluded that antibiotic prophylaxis is not indicated, but that view is controversial.

Thoracic (Non-Cardiac) Surgery – Antibiotic prophylaxis is used routinely in thoracic surgery, but supporting data remain sparse. In one study, a single preoperative dose of cefazolin before pulmonary resection led to a decrease in the incidence of surgical site infection, but not of pneumonia or empyema.
major lung resection found that 24% developed postoperative pneumonia despite antibacterial prophylaxis; the study did not evaluate surgical site infections.60 Other trials have found that multiple doses of a cephalosporin can prevent infection after closed-tube thoracostomy for chest trauma with hemo- or pneumothorax.61 Insertion of chest tubes for other indications, such as spontaneous pneumothorax, does not require antimicrobial prophylaxis.

Vascular Surgery – Preoperative administration of a cephalosporin decreases the incidence of postoperative surgical site infection after arterial reconstructive surgery on the abdominal aorta, vascular operations on the leg that include a groin incision, and amputation of the lower extremity for ischemia.62,63 Many experts also recommend prophylaxis for implantation of any vascular prosthetic material, such as grafts for vascular access in hemodialysis. Prophylaxis is not indicated for carotid endarterectomy or brachial artery repair without prosthetic material.

Other Procedures – Antimicrobial prophylaxis is generally not indicated for cardiac catheterization, varicose vein surgery, most dermatologic and plastic surgery, arterial puncture, thoracentesis, paracentesis, repair of simple lacerations, outpatient treatment of burns, dental extractions or root canal therapy because the incidence of surgical site infections is low.

The need for prophylaxis in breast surgery, herniorrhaphy and other “clean” surgical procedures has been controversial. Medical Letter consultants generally do not recommend surgical prophylaxis for these procedures because of the low rate of infection and the potential adverse effects of prophylaxis in such a large number of patients; some recommend prophylaxis for procedures involving placement of prosthetic material (e.g., synthetic mesh, saline implants, tissue expanders).

Antimicrobial Prophylaxis for Surgery

41. SA Sullivan et al. Administration of cefazolin prior to skin incision is superior to cefazolin at cord clamping in preventing postcesarean infectious morbidity: a randomized controlled trial. Am J Obstet Gynecol 2007; 196:455.

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The expected outcome of the CME Program is that knowledge and consideration of the information contained in Treatment Guidelines can affect health care practice.

The Medical Letter will strive to continually improve the CME program through periodic assessment of the program and activities. The Medical Letter aims to be a leader in supporting the professional development of health care professionals by providing continuing medical education that is unbiased and free of industry influence.

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Activity participants will read and assimilate unbiased reviews of FDA-approved and off-label uses of drugs and drug classes. Participants will be able to select and prescribe, or confirm the appropriateness of the prescribed usage of the drugs and other therapeutic modalities discussed in Treatment Guidelines with specific attention to clinical evidence of effectiveness, adverse effects and patient management. Through this program, The Medical Letter expects to provide the prescribing health care community with educational content that they will use to make independent and informed therapeutic choices in their practice.

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**Issue 82 Questions**

1. For most procedures, an effective choice would be:
   a. cefazolin
   b. vancomycin
   c. ciprofloxacin
   d. metronidazole

2. Prophylactic antimicrobials should be given:
   a. daily for 3 days before surgery
   b. 24 hours before surgery
   c. 60 minutes before surgery
   d. at the time of the initial incision

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Issue 82 Questions continues on page >>
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
<th>Page</th>
</tr>
</thead>
</table>
| 3. Postoperative doses of antimicrobials: | a. are often used  
b. are usually unnecessary  
c. can increase the risk of antimicrobial resistance  
d. all of the above | 47 |
| 4. For prophylaxis in hospitals in which MRSA are a frequent cause of postoperative wound infections, it would be reasonable to use: | a. cefoxitin  
b. ciprofloxacin  
c. metronidazole  
d. vancomycin | 48 |
| 5. Before biliary tract surgery, antimicrobial prophylaxis is recommended for patients: | a. more than 70 years old  
b. with a non-functioning gall bladder  
c. with obstructive jaundice  
d. all of the above | 48, 49 |
| 6. Mechanical bowel preparation before colorectal surgery: | a. is cost-effective  
b. is effective in preventing infection  
c. is always recommended  
d. none of the above | 49, 50 |
| 7. Antimicrobial prophylaxis decreases the incidence of infection after: | a. vaginal, but not abdominal, hysterectomy  
b. abdominal, but not vaginal, hysterectomy  
c. both vaginal and abdominal hysterectomy  
d. none of the above | 50 |
| 8. Before eye surgery, most ophthalmologists use: | a. cefazolin  
b. clindamycin  
c. antimicrobial eye drops  
d. vancomycin | 50 |
| 9. In joint replacement, prophylactic antimicrobials: | a. can decrease the incidence of early infection  
b. can decrease the incidence of delayed infection  
c. can decrease the incidence of both early and delayed infection  
d. none of the above | 50 |
| 10. For cardiac catheterization, antimicrobial prophylaxis: | a. is generally not indicated  
b. should be with cefazolin  
c. should be with metronidazole  
d. should be with vancomycin | 51 |
| 11. For repair of simple lacerations, antimicrobial prophylaxis: | a. is generally not indicated  
b. should be with topical mupirocin  
c. should be with cefazolin  
d. should be with ampicillin/sulbactam | 51 |
| 12. In clean surgery such as breast surgery or herniorraphy, antimicrobial prophylaxis might be indicated for: | a. a patient more than 70 years old  
b. a procedure that involves placement of prosthetic material  
c. an immunosuppressed patient  
d. all of the above | 51 |