

Rational Use of Pre-Surgical Antibiotics

Lauren A. Trepanier, DVM, PhD, DACVIM, DACVCP
University of Wisconsin-Madison
Madison, WI

Pre-surgical antibiotics are indicated for specific types of surgical procedures and in patients with certain risk factors for infection. In other situations, perioperative antimicrobials are not rational, only add to the cost of hospitalization, may lead to adverse reactions or drug interactions, and can encourage the selection of resistant bacteria in an individual patient or on a hospital-wide basis.

- I. Cases for which antimicrobials are not indicated
 - A. Patients undergoing uncontaminated, short surgical procedures
 1. For example, ovariohysterectomy, castration, skin mass removal, some splenectomies
 2. If less than an hour in duration, these cases do not require prophylactic antimicrobials.
 - a) In one study of 122 dogs undergoing short duration, clean surgical procedures, there was no difference in the rate of infection in those animals given ampicillin compared to those given placebo
- II. Cases for which antimicrobials are indicated
 - A. Surgical sites with expected contamination
 1. Even if contamination can be controlled, contaminated surgery sites warrant prophylactic antibiotics.
 2. This includes all procedures that enter the GI, lower urogenital, oropharyngeal, or respiratory tracts, such as:
 - a) Gastrotomy, enterotomy, subtotal colectomy
 - b) Urethrostomy, vaginoplasty
 - c) Oral tumor removal, palate surgery
 - d) Dental surgeries
 - e) Larynx, tracheal or lung surgery
 3. This includes sites that are difficult to decontaminate, which also warrant prophylaxis
 - a) Ocular surgeries
 - b) Ear canal ablations
 - B. Surgical procedures of prolonged duration
 1. Prolonged anesthesia alone has been correlated with an increased risk of infection in dogs and cats
 - a) This may be due to hypothermia, hypotension, and decreased tissue perfusion
 2. Procedures greater than 60-90 minutes in duration warrant prophylactic antimicrobials.
 - a) Infection risk doubles for every 70 minutes of surgery, according to one study of more than 1000 surgeries in dogs and cats in Switzerland
 3. In dogs undergoing elective orthopedic surgery, prophylactic antibiotics have been shown to decrease the rate of postoperative infection compared to placebo
 - a) Preventing infection in orthopedic procedures is particularly important, since infection at the site of bone healing can have disastrous consequences for return to function.
 - C. Preexisting infection at the surgical site
 1. ...an obvious indication for intra- and post-operative antimicrobial therapy.
 2. If the infection is long-standing or recurrent, tissue should always be submitted for culture and sensitivity.
 - a) Always include an aerobic *and anaerobic* culture if the wound is deep or walled off.
 3. If devitalized tissue is present, it should be debrided appropriately, since antibiotics will not penetrate tissue without adequate blood flow.
 4. Topical antibiotics are not useful in such instances, because they will be inactivated in the presence of necrotic debris.
 - D. The presence of devitalized tissue, tissue dessication, or traumatic tissue handling
 1. Intraoperative tissue dessication or traumatic tissue handling increases the risk of post-surgical infection.
 2. In one study, antimicrobials were not necessary in preventing infection in surgeries performed by experienced veterinary surgeons, but antimicrobials did reduce the incidence of infections in surgeries performed by inexperienced veterinary students
 3. For practicing veterinarians, it makes more sense to focus on good surgical technique than to rely on antimicrobials to compensate for poor tissue handling.
 - E. A compromised host
 1. Immunodeficient
 - a) Immunodeficient human patients have a higher risk of surgical infections and poor wound healing

- b) For example, feline leukemia (FeLV) or feline immunodeficiency virus (FIV) infected cats, or patients with neutropenia, may benefit from antimicrobial prophylaxis prior to surgery.
 - 1) This is particularly important for procedures for which the gastrointestinal tract, lower urogenital, or upper respiratory tract are entered.
 - 2) In these patients, bactericidal antibiotics provide a theoretical advantage.
- 2. Endocrinopathies
 - a) Human patients with diabetes mellitus have a higher risk of surgical infections
 - 1) However, since human diabetics develop peripheral vascular disease but dogs and cats do not, this increased risk may not translate directly to diabetic dogs and cats.
 - b) Hyperadrenocorticism and hypothyroidism have been associated with increased surgical site infections in dogs
 - 1) Although no studies have been published comparing surgical infection rates in dogs with controlled versus uncontrolled hyperadrenocorticism, delayed wound healing and incision dehiscence are common surgical complications in dogs with untreated hyperadrenocorticism
 - 2) Whenever possible, hyperadrenocorticism should be treated and controlled *before* elective surgeries

III. Timing of antimicrobial therapy

- A. The following recommendations are the standard of care in humans (National Surgical Infection Prevention Project):
 - 1. Parenteral antimicrobials within one hour before incision
 - 2. Re-dose every 1-2 elimination half-lives during prolonged procedures
 - 3. Discontinuation of prophylactic antimicrobials after wound closure

IV. Selection of an antimicrobial regimen

- A. Orthopedic procedures:
 - 1. Coverage should be targeted at skin flora (i.e. Staph. pseudintermedius) that may cause deeper wound contamination.
 - 2. Cefazolin has been shown to be effective in preventing infection after orthopedic procedures in dogs when given at 20 mg/kg at induction, followed by 20 mg/kg IV every 90 minutes thereafter until wound closure.
 - a) The same study demonstrated that potassium penicillin G was also effective, compared to placebo, in this setting
 - b) However, cefazolin, and related first generation cephalosporins, remain the standard for orthopedic prophylaxis because of their spectrum against many beta-lactamase-producing Staph.
- B. Dental procedures:
 - 1. There are two considerations with dental procedures:
 - a) Treatment of pre-existing gingival or periodontal infections
 - 1) Treatment of pre-existing infection prior to definitive dental procedures may decrease tissue inflammation and bleeding at the time of oral surgery
 - 2) Amoxicillin-clavulanate, clindamycin, and metronidazole are each effective against Gram positive and anaerobic gingival flora in dogs and cats.
 - b) Control of bacteremia during dental prophylaxis
 - 3) Probably not a concern in most animals
 - i. “Healthy animals are able to overcome this bacteremia without the use of systemic antibiotics” (American Veterinary Dental College position statement, 2004)
 - 4) Antibiotic therapy prior to dental prophylaxis is only recommended for human patients with:
 - i. Joint prostheses
 - ii. Artificial heart valves
 - iii. Prior endocarditis
 - iv. Prior cardiac transplant
 - 5) The American Veterinary Dental College recommends antibiotics at the time of dental prophylaxis only in “animals that are immune compromised, have underlying systemic disease (such as clinically-evident cardiac, hepatic, and renal diseases) and/or when severe oral infection is present.”
 - 6) For dental prophylaxis in at-risk patients, antibiotics should be given one hour prior to the dental procedure
 - i. Note: long acting antibiotics, such as Convenia, are inappropriate in this setting

- ii. Additional treatment after the procedure is not indicated unless there is a clear underlying infection
- C. Gastric, biliary, and small intestinal surgery:
 1. Because these procedures involve entering a contaminated body cavity, antimicrobial prophylaxis is warranted.
 - a) Treatment prior to incision is the key to efficacy.
 2. Coverage should be aimed primarily at anaerobes and routine Gram negative enterics such as *E. coli*.
 - a) Ampicillin, cefazolin, or cefotetan are reasonable choices, given within 30 minutes prior to incision
 3. For soft tissue surgeries, a bolus dose of 20 mg/kg cefazolin IV given at the time of surgery, followed by a second dose of 20 mg/kg SC 6 hours later, was shown to provide adequate drug concentrations at the surgical wounds for more than twelve hours postoperatively in experimental dogs.
 - a) Longer duration of administration is not necessary.
- D. Colonic surgery:
 1. Surgery involving the colon carries a relatively high risk of surgical site infection and bacterial peritonitis.
 2. In humans, the standard of care for colorectal surgery is both oral and intravenous antibiotic prophylaxis.
 - a) Systemic coverage for anaerobes and Gram-negative enterics is warranted.
 - b) Typical regimens include oral neomycin and erythromycin given in divided doses the day before surgery, followed by ampicillin-sulbactam, cefotetan, or metronidazole / cefazolin, given IV one hour prior to incision.
 - c) Human studies do not support the administration of additional antimicrobials beyond wound closure.
 3. If surgery is urgent, cefotetan (a broad spectrum second generation cephalosporin) can be administered at induction and for 24 hours postoperatively.
 4. Although mechanical irrigation prior to colonic procedures makes intuitive sense, and is widely used in both human and veterinary patients, it has shown no benefit in reducing postoperative complications in humans.
 - a) Notably, mechanical irrigation has actually been associated with an *increased* risk of abdominal infections in colorectal surgeries in humans, possibly due to mucosal inflammation and loss of colonic mucus.
- E. Bladder surgery:
 1. Prophylactic antibiotics do not reduce the incidence of wound infection after bladder surgery in immunocompetent humans.
 - a) However, antibiotic prophylaxis is recommended for *immunocompromised* patients (patients on chemotherapy, with Cushing's, or with neutropenia) prior to cystotomy
 - 1) Single dose of a cephalosporin or fluoroquinolone
 2. For stable patients with documented or suspected pre-existing urinary tract infections, there are two options prior to bladder surgery:
 - a) Culture urine pre-operatively, and treat infection for a week or more prior to elective surgery, or
 - b) Obtain cultures at surgery, and treat based on results
 3. If postoperative urinary catheterization is necessary:
 - a) Minimize duration of catheterization (intermittent clean catheterization may be preferred over indwelling catheter, if possible, e.g. in male dogs)
 - b) Use scrupulous clean technique
 - c) Always use a closed collection system
 4. Treat with antimicrobials if clinical signs of urinary tract infection, with bacteriuria, develop
 - a) Do not treat asymptomatic bacteriuria diagnosed during or immediately after urinary catheterization
 - b) Consider culturing urine 3 days after catheter removal
 - c) If cystocentesis is contraindicated (i.e. recent bladder surgery), collect a mid-stream voided sample and request a quantitative culture
 - 1) 10,000 cfu/ml is significant growth in a cultured mid-stream voided sample
- V. Other prophylactic measures to prevent peri-operative infections
 - A. Shave animals after anesthetic induction
 1. Shaving animals prior to anesthetic induction has been associated with an almost 3-fold higher incidence of surgical site infection compared to dogs and cats clipped after anesthetic induction.
 2. This has also been demonstrated in humans shaved the night before surgery, and is most likely due to small skin nicks that have time to become colonized by bacteria.
 - B. Use care with multi-dose vials

1. The use of multi-dose 20 ml vials of propofol, without preservatives, has been associated with higher rates of SSI in dogs and cats, compared to patients not given propofol, under conditions in which vials were shared among patients or syringes were pre-filled more than 6 hours prior to use
- C. Maintain core body temperature during surgery
 1. Hypothermia increases wound infection rates
 - a) Hypothermia causes secondary vasoconstriction and decreased blood flow to the wound site
 - b) Hypothermia leads to impaired innate immune function
 2. Supplemental warming during anesthesia reduces postoperative infection by 5-14% in human patients
- D. Minimize the number of people in the operating room
 1. For each additional person in the surgical suite, veterinary patients were found to be 1.3 times more likely to develop post-operative infections
- E. Adhere to consistent, high quality postoperative nursing care
 1. Alcohol-based hand sanitizers between every patient
 2. Exam gloves when examining every incision
 3. Get recumbent dogs up to walk and urinate frequently