THE USE OF PROPHYLACTIC ANTIMICROBIALS IN SURGICAL INTERVENTIONS

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· Abstract

Antimicrobial prophylaxis is used by clinicians for the avoidance of numerous infections, consisting of sexually transmitted diseases, human immunodeficiency infection, tuberculosis, rheumatic fever, persistent cellulitis, meningococcal disease, persistent straightforward urinary tract infections in women, spontaneous bacterial peritonitis in patients with cirrhosis, influenza, malaria, infective endocarditis, pertussis, pester, anthrax, early-onset group B streptococcal disease in neonates, and animal bite wounds. Certain opportunistic infections such as Pneumocystis carinii pneumonia in immunocompromised patients also can be effectively avoided with main antimicrobial prophylaxis. Perioperative antimicrobial prophylaxis is suggested for numerous surgeries to pre- vent surgical website infection. In conclusion, the main prophylactic step against postoperative infection is antiseptic technique in patient preparation, throughout surgery, and in postoperative patient care. Since the anticipated benefit of antimicrobial treatment is less than the danger of an unfavorable medication response, antimicrobial prophylaxis against postoperative infection is not indicated for procedures with a low infection rate. Antimicrobial prophylaxis has been shown to be of higher advantage than risk in some procedures with greater infection rates; however, because the problem is complicated and the data are limited, extrapolating these findings to the specialist's setting and the specific patient remains an obstacle. Antimicrobial prophylaxis for bacterial endocarditis is ineffective for a lot of patients, the seriousness of the prospective infection has driven the production of standards suggesting prophylaxis for at-risk patients going through at-risk procedures. Using these standards appropriately might help to lower baseless use of antimicrobials. In the prophylactic use of antimicrobials, as in lots of medical interventions, the problem is balancing the risks of the intervention with the possible advantages. We do not have actually either the randomized, controlled trials or the in-depth, patient-specific details to

approximate this balance exactly, there are basic guidelines to help the clinician pick treatment for the majority of patients.

· Introduction

Surgery has been carried out for countless years, until modern-day times individuals went through surgery only in desperation, in part due to the truth that they were most likely to pass away of postoperative infection. With the advancement of antibacterial techniques in the late 1800s, surgery ended up being substantially more safe and secure; nevertheless, postoperative infection remained a significant factor for operative morbidity and death. After antimicrobials got in medical practice in the 1950s, cosmetic surgeons started to use them prophylactically with the objective of preventing postoperative infections. Over the subsequent 50 years, there have actually been lots of trials taking a look at the benefits and risks of prophylactic antimicrobials. Great deals of uncertainties stay, prophylactic antimicrobials are presently a crucial part of outstanding perioperative care for various types of surgery.

Surgical website infection (SSI) is infection occurring in an injury created by a surgical procedure or postoperative infection of any cavity, bone, joint or tissue that was associated with the surgery. It consists of infection of prostheses placed throughout an operation.1 SSI is diagnosed if infection happens within 30 days of surgery (or within one year when an implant is affected), and is categorized according to the tissues involved:

- ® superficial incisional infection including only skin or subcutaneous tissue at the cut site.
- ® Deep incisional infection including deep soft tissues (e.g. fascial and muscle layers) of the incision.
- ® Organ space infection including any part of the anatomy aside from the cut that was opened or controlled throughout the operation.

SSI is a typical postoperative complication, affecting nearly 5% of patients total and accounting for 14% of healthcare- associated infections.3 The real occurrence of SSI might in fact be greater provided the increasing proportion of surgery done on a day-case basis; many cases are now determined and dealt with in the community.

SSI can result in increased length of stay and extra costs in the order of hundreds to thousands of pounds depending on the intensity and site of infection.5 Consequences for patients consist of the need for additional surgery, additional antibiotic therapy and unfavorable effects associated with this, scarring, long-term discomfort, and impact on emotional wellness. SSI impacting anastomotic or graft websites can be life or limb threatening; SSI contributes to a minimum of a third of all postoperative deaths.

Threat of SSI occurs when there is bacterial contamination of the injury; the advancement of infection is then moderated by the virulence of the polluting organism and the host's natural immunological defences. The organisms that cause SSI are usu- ally endogenous to the patient and originate from their skin or any viscus that is opened. Exogenous infection develops when the injury is infected preoperatively (e.g. a distressing wound), perioperatively from instruments or the theatre environment, or postoperatively before the injury has actually recovered. Surgery can also include transient bacteraemia, which is an important mechanism in the advancement of infection at implant sites distant to the infection. Antimicrobial prophylaxis targets the perioperative risk of infection.

· Results and Discussion

Antimicrobial prophylaxis for surgical site infection and sepsis

Postoperative infections

Bacteria presented into usually sterilized body sites are the dominant cause of postoperative infection. Immunosuppression from perioperative tension, and from concomitant treatments such as blood transfusion, may likewise contribute to postoperative infection *(Hebert et al.,1999)* .Although postoperative fungal infections remain much less common than bacterial infections, postoperative fungal infections are ending up being more regular, particularly in immunosuppressed patients*(Calvo et al.,1999;Mangram et al.,1999)*. The most obvious and regular area for a postoperative infection is the surgical site, but pneumonia is also a typical postoperative infection in prone patients undergoing surgical treatments that involve endotracheal intubation or jeopardize the breathing system, thorax, or upper abdominal area*(Arozullah et al.,2001;Smetana et al.,1999).*Although we typically speak about" wound" infetions, these can be

more clearly referred to as surgical website infections and further defined by the depth of infection and by the presence or lack of a foreign body or prosthetic product*(Mangram et al.,1999)*.In addition to surgical website and pulmonary infections, bacteremia from these infections or from catheters can cause sepsis and to endocarditis*(Dajani et al.,1997)*. Lastly, urinary tract infections happen in surgical patients, normally as a consequence of an indwelling urinary catheter*(Eggimann et al.,2001)*.

Nonantimicrobial strategies for reducing postoperative infection

In addition to antimicrobials and standard antiseptic surgical method*(Mangram et al.,1999)*, some nonantimicrobial strategies have been shown to decrease the occurrence of postoperative infection, consisting of keeping normal body temperature level*(Kruz et al.,1996)*, maintaining typical blood sugar level levels*(Van den Berghe G et al.,2001)*, and hyperoxygenation*(Greif R et al.,2000)*

Kurz et al [8] randomized 200 patients going through colorectal surgery to routine intraoperative thermal care or to supplemental warming. Blinded investigators examined the surgical websites for infection daily till discharge and at a 2-week follow-up clinic see. Surgical website infection was specified as culture-positive purulent drain. Final intraoperative core temperature level was 34.7 ° C in patients randomized to regular care and 36.6 ° C in patients randomized to additional warming. Surgical website infection happened in 18 (19%) of 96 patients randomized to regular care, however in only 6 (6%) of 104 randomized to extra warming (P 1⁄4 0.009).

Van den Berghe et al [9] randomly designated adults who were admitted to the surgical intensive care unit (SICU) on a mechanical ventilator, to receive either standard insulin treatment to maintain blood sugar below 210 mg/dL, or extensive insulin treatment to maintain blood sugar between 80 and 110 mg/dL. The study was terminated early, after the registration of 1548 patients, because 8.0% of patients getting standard treatment had actually expired in the SICU, compared with just 4.6% of patients getting intensive treatment (P 1⁄4 0.04). The reduction in SICU death was mainly caused by a decrease in multiple-organ failure with a tested septic focus in patients who remained in the SICU for more than 5 days (20.2% conventional treatment, 10.6% intensive treatment, P1⁄40.005). Intensive insulin treatment also reduced general in-hospital death by 34%, and blood-stream infections by 46%.

Greif et al [10] randomly designated 500 patients going through colorectal resection to get either 30% or 80% influenced oxygen during the operation and for 2 hours afterward. Blinded detectives evaluated the surgical websites for infection daily up until discharge and at a 2-week follow-up clinic visit.

Surgical website infection was specified as culture-positive purulent drain. Arterial oxygen saturation was regular in both groups; however, the arterial and subcutaneous partial pressure of oxygen was considerably greater in the patients randomized to 80% oxygen. Surgical site infection happened in 28 (11.2%) of 250 patients randomized to 30% influenced oxygen, but in just 12 (5.2%) of 250 patients randomized to 80% motivated oxygen (P 1⁄4 0.01).

The 3 clinical trials described above can be slammed (for example, the control patients in Kurz's study had an extremely high infection rate, and investigators in Van den Bergh's study were not blinded), the interventions have a solid physiologic basis and are supported by the findings of other research studies in humans and other animals. Allogenic blood transfusion is another risk aspect for postoperative infection *(Leal-Noval S et al.,2001;Tang R et al.,2001)*; however, blood transfusion is also a general procedure of seriousness of health problem, and randomized trials restricting allogenic blood transfusion have actually cannot reveal a considerable advantage*(Wong J et al.,2002)*. In sum, assiduous maintenance of homeostasis, consisting of body temperature, blood sugar, and tissue oxygenation in the perioperative duration can considerably lower postoperative infection.

Benefits and risks of antimicrobials

The benefits of perioperative antimicrobial prophylaxis include a decrease in surgical site infection, pneumonia, sepsis, endocarditis, and urinary tract infection. The threats include allergies to antimicrobials, toxic effects of antimicrobials, adverse interactions of antimicrobials with other medications, selection pressure for the introduction of antimicrobial-resistant organisms, and the expense of the antimicrobials. Therefore, making use of antimicrobial prophylaxis must be restricted to those operations with high infection rates or severe consequences of infection *(Scand J.1998)*.

Principles of perioperative antimicrobial use

Perioperative antimicrobial prophylaxis is directed versus the most likely contaminating organisms and does not need to cover every potential pathogen *(Waddell T et al.,1995)*. In surgeries not going into a chronically colonized body cavity, surgical site infections are probably to be brought on by skin organisms such as staphylococci and streptococci. Cefazolin is effective against these organisms and is for that reason usually proper for these kinds of surgeries. Although pro- phylactic vancomycin might be appropriate for patients at high threat for infection with methicillin-resistant staphylococci, a randomized trial in a high-risk setting cannot reveal benefit *(Finkelstein et al.,2002)*, and vancomycin usage promotes the introduction of resistant organisms, specifically enterococci *(Kaye K et al.,2000)*.

Antimicrobial prophylaxis for surgeries including the lower gastrointestinal system needs to cover gram-negative enteric germs and bowel anaerobes, especially Bacteroides fragilis. Cefoxitin and cefotetan are appropriate for such surgeries.

Third-generation cephalosporins cefotaxime, ceftriaxone, cefoperazone, ceftizoxime, ceftizoxime and fourth-generation cephalosporins such as cefepime are contraindicated for antimicrobial prophylaxis since: (1) the majority of them are less active than cefazolin versus organisms most likely to cause postoperative infection such as staphylococci, (2) they are active versus organ- isms that seldom trigger postoperative infection, (3) their use promotes the development of resistance organisms, particularly enterococci, and (4) they are more pricey than more effective alternatives*(Tanos V et al.,2000)* .

Penicillin allergy

Patient report of penicillin allergy is notoriously unreliable. Roughly 85% of patients who report penicillin allergic reaction do not have an allergic reaction when assessed by skin testing*(Salkind et al.,2001)*. Patients who are not penicillin-allergic by skin screening can securely get penicillin*(Solensky et al.,2002)*. Use of alternate antimicrobials, particularly vancomycin, for surgical prophylaxis in patients reporting penicillin allergy increases cost and increases the occurrence of antimicrobial-resistant bacteria, such as vancomycin-resistant enterococci. A cost-effectiveness analysis that did not represent the increased frequency of antimicrobial- resistant germs found that routine preoperative skin screening of cardiovascular surgery patients reporting penicillin allergy was more cost-efficient than routine use of vancomycin*(Phillips E et al.,2000)*.

A 6-month clinical trial of regular preoperative skin testing in elective orthopedic surgery patients reporting allergy to penicillins or to cephalosporins found a substantial decrease in vancomycin use and no instances of instant antimicrobial response*(Li J et al.,2000)*. To decrease the cost of surgical antimicrobial prophylaxis, and to lower the occurrence of antimicrobial-resistant bacteria, it is probably worth using skin testing when practical to assist the option of a prophylactic antimicrobial in patients reporting penicillin allergy prior to surgery.

Duration of antibiotic prophylaxis after surgery

Usually, a single dose of antimicrobial within 1/2 hour prior to skin incision works infection prophylaxis*(Kriaras I et al.,2000)*. If given more than 2 hours prior to skin incision [an antimicrobial is measurably less efficient*(Bruke J et al.,1961;Classen D et al.,1992)*] If the surgery lasts longer than 4 hours, or includes major blood loss, or the anti- microbial has a really brief half-life (eg, cefoxitin) then extra doses of antimicrobial may be of benefit. Lots of surgeons continue antimicrobials for 2-3 days after surgery with the reasoning that surgical wound drains pipes and intravenous catheters might lead to bacterial seeding of the surgical website; however, there is proof that this practice does not more decrease the threat of infection*(Carrel T et al.,2001;Coskun H et al.,2001;Mcdonald M et al.,1998)*.

Considerations for specific surgeries (Table 1)

Cardiac procedures

Antimicrobial prophylaxis with cefazolin minimizes the risk of infection after heart procedures, consisting of the transvenous pacemaker positioning *(Da Costa et al.,1998)*. In institutions with a high danger of infection with methicillin-resistant staphylococci, vancomycin may be an appropriate alternative, though a randomized trial in a high-risk setting cannot show benefit*(Finkelstein R et al.,2002)*. A creation friend research study showed a reduction in sternal injury infection after heart surgery in patients treated with intranasal mupirocin prior to and after surgery *(Cimochowski et al.,2001)* .

Gastrointestinal procedures

Antimicrobial prophylaxis is not needed for routine, uncomplicated gastrointestinal endoscopy. Some clinicians use prophylaxis for sclerotherapy of varices, and for esophageal dilation. Most of them use prophylaxis for percutaneous feeding tube placement*(Kulling D et al.,2000;Sharma V et*

al.,2000). Antimicrobial prophylaxis reduces infection risk in esophageal procedures with obstruction, and in gastroduodenal surgery with risk factors for infection including obstruction or decreased motility, decreased gastric acidity, gastrointestinal hemorrhage, ulcer, cancer, and morbid obesity. The most appropriate antimicrobial agents are usually cefazolin or cefoxitin. Prophylaxis is also appropriate in biliary tract procedures including endoscopic retrograde cholangiopancreatography (ERCP) for patients with risk factors for infection including age over 70, acute cholecystitis, obstruction, common duct stones, and a nonfunctioning gallbladder. Prophylactic antimicrobials are unnecessary for low-risk patients undergoing elective laparoscopic cholecystectomy*(Dobay K et al.,1999;Higgins A et al.,1999;Tocchi A et al,.2000)*. In elective colorectal surgery, selective decontamination of the gastrointestinal tract with oral neomycin and erythromycin is approximately as effective as parenteral antimicrobials *(Nathens A et al.1999)* Many clinicians use both, but it is not clear that this is more effective than either alone. A preoperative parenteral antimicrobial decreases the incidence of surgical site infection after appendectomy. An antimicrobial is recommended for treatment of the infection and should be continued as long as clinically appropriate if the appendix has ruptured. Prophylactic antimicrobials are probably unnecessary in uncomplicated inguinal herniorraphy, a single dose of ampicillin-sulbactam can reduce the infection rate in herniorraphy with mesh repair *(Yerdel M et al.,2001)* .

Table 1: Antimicrobial prophylaxis for surgery

Procedure	**Likely pathogens**	**Antimicrobiala**
Cardiac: pacemaker or defibrillator insertion, and open heart, eg, coronary artery bypass and prosthetic valve	Staphylococci, corynebacteria, enteric gram- negative bacilli	Cefazolinb 1–2 gm IV, or cefuroximeb 1.5 gm IV, or vancomycinc 1 gm IV
Gastrointestinal: appendectomy without perforation	Enteric gram-negative bacilli, anaerobes, enterococci	Cefoxitin 1–2 gm IV or cefotetan 1–2 gm IV
Gastrointestinal: biliary tract, in a high-riskd patient only	Enteric gram-negative bacilli, enterococci, clostridia	Cefazolin 1–2 gm IV, or cefoxitin 1–2 gm IV, or cefotetan 1–2 gm IV
Gastrointestinal: colorectal	Enteric gram-negative bacilli, anaerobes, enterococci	Oral: neomycin plus erythromycin basee Intravenous: cefoxitin 1–2 gm IV, or

		cefotetan 1–2 gm IV or cefazolin 1–2 gm IV plus
Gastrointestinal: esophageal, gastroduodenal, in a high-riskf patient only	Enteric gram-negative bacilli, gram-positive cocci	cefazolin 1–2 gm IV
Genitourinary: in a high-riskg patient only	Enteric gram-negative bacilli, enterococci	Oral: ciprofloxaxin 0.5 gm PO or trimethoprim-sulfamethoxazole 160–800 mg PO Intravenous: ciprofloxacin 0.4 gm IV trimethoprim-sulfamethoxazole 160–800 mg IV
Gynecologic/obstetric: abortion, first trimester, in a high-riskh patient only	Enteric gram-negative bacilli, anaerobes, enterococci, group B strep	Oral: doxycycline 300 mg POi Intravenous: aqueous penicillin G 2 million units IV
Gynecologic/obstetric: abortion, second trimester	Enteric gram-negative bacilli, anaerobes, enterococci, group B strep	Cefazolin 1 gm IV
Gynecologic/obstetric: cesarean section, in a high-riskj patient only	Enteric gram-negative bacilli, anaerobes, enterococci, group B strep	Cefazolin 1 gm IV after cord clamping
Gynecologic/obstetric: hysterectomy: vaginal or abdominal	Enteric gram-negative bacilli, anaerobes, enterococci, group B strep	Cefoxitin 1–2 gm IV, or cefotetan 1–2 gm IV, or cefazolin 1–2 gm IV
Head and neck: with incision through oral or pharyngeal mucosa	Oral anaerobes, enteric gram-negative bacilli, staphylococci	Ampicillin-sulbactam 1.5–3 gm IV or clindamycin 600–900 mg IV, plus gentamicin 1.5 mg/kg IV or cefazolin 1–2 gm IV
Neurologic: craniotomy Ophthalmic	Staphylococci Staphylococci, streptococci, enteric gram-negative bacilli, Pseudomonas aeruginosa	Cefazolin 1–2 gm IV or vancomycinc 1 gm IV Topical drops over 2–24 hours: gentamicin, or tobramycin, or ciprofloxacin, or ofloxacin, or neomycin-gramicidin-polymyxin B
Orthopedic Thoracic: noncardiac	Staphylococci Staphylococci, streptococci, enteric gram- negative bacilli	Subconjunctival: cefazolin 100 mg Cefazolin 1–2 gm IV or vancomycinc 1 gm IV Cefazolin 1–2 gm IV, or cefuroxime 1.5 gm IV, or vancomycinc 1 gm IV

Vascular: arterial repair, prosthetic material, abdominal aorta	Staphylococci, streptococci	Cefazolin 1–2 gm IV or vancomycinc 1 gm IV
Vascular: groin incision, leg amputation for arterial insufficiency	Staphylococci, streptococci, enteric gram- negative bacilli, clostridia	Cefoxitin 1–2 gm IV or vancomycinc 1 gm IV

Gynecologic and obstetric

Antimicrobial prophylaxis can reduce the incidence of infection after both abdominal and vaginal hysterectomy *(Tanos V et al.,1994;Kamat A et al.,2000).* Antimicrobials can decrease the occurrence of infection, even when offered throughout high-risk obstetrical occasions such as emergency situation cesarean section, premature rupture of mem- branes, and active labor in high-risk ladies*(Chelmow et al.,2001).* Preoperative antimicrobial prophylaxis reduces infection threat after mid-trimester abortion, and after first-trimester abortion in high-risk ladies, and might reduce infection threat in all females undergoing restorative abortion*(Sawaya G et al.,1996)* .

Head and Neck

Prophylactic intravenous antimicrobials reduce surgical site infections after head and neck surgeries including cut through the oral or pharyngeal mucosa*(Weber R et al.,1997).* Preferred antimicrobials for prophylaxis in tidy-polluted head and neck surgeries must have activity versus the gram-negative and gram-positive aerobic germs, and the anaerobic germs found in the oropharynx, and include mixes such as ampicillin- sulbactam (UnasynÒ), and clindamycin plus gentamicin *(Callender D et al.,1999;Rodrigo J et al.,1997).* Washing the surgical site with antimicrobials does not more reduce the infection rate*(Simons J et al.,2001).*Antimicrobial prophylaxis is not indicated for endoscopic sinus surgery without nasal packaging*(Annys et al.,2000).*

Neurologic

Antimicrobial prophylaxis can reduce infection rates after craniotomy *(shapiro M et al.,1986;Young R et al.,1987)*; nevertheless, some have actually argued that only high-risk patients,

such as those undergoing repeat growth resection benefit properly(*Tenney J et al.,1985)*. Antimicrobial prophylaxis is most likely not shown for routine back discectomy; nevertheless, it might benefit patients going through spinal treatments that are prolonged or involve blend or foreign materials*(Dimick J et al.,2000)*.

Ophthalmic procedures

Although prophylactic 1% chloramphenicol ophthalmic ointment can avoid corneal ulcer in rural patients with corneal abrasion *(Upadhyay M et al.,2001)* and ciprofloxacin ophthalmic option can focus on corneal problems *(Eiferman R et al.,2001)*, there are no well-controlled trials of antimicrobial prophylaxis in ophthalmic surgery. However, because postoperative endophthalmitis is a severe complication, antimicrobial eye drops are appropriate for treatments that attack the globe, and subconjunctival antimicrobials might be appropriate for high-risk patients(*Gordon Y et al.,2001;Liesegang et al.,1999)* . Similar to all surgeries, antibacterial surgical setting and technique are the structure of infection prophylaxis*(Tabbara K et al.,1998)*.

Orthopedic procedures

Antimicrobial prophylaxis prior to surgery lowers the occurrence of both early and late surgical website infection after joint replacement, and after repair work of both open and closed fractures*(Boxma H et al.,1996;Gillespie et al.,2001)*. Antimicrobial prophylaxis is most likely not shown for either restorative or diagnostic, regular arthroscopic surgery*(Wieck J et al.,1997)*. It is reasonable to provide antimicrobial prophylaxis to patients with prosthetic joints who are going through intrusive dental work and are at high threat for prosthetic joint infection*(Segreti J et al.,1999)*. Risk elements for prosthetic joint infection include current joint placement (less than 1 year), rheumatoid arthritis, gross oral infection (eg, abscess), prolonged intrusive dental work (more than 1 hour), and, possibly, diabetes mellitus and immunosuppressive corticosteroid treatment. Nonetheless, prosthetic joint infection from oral work is rare and the dangers of prophylactic antimicrobial treatment most likely outweigh the benefits for many patients with prosthetic joints.

Thoracic procedures

There is limited details on the efficacy of antimicrobial prophylaxis for noncardiac chest procedures; nevertheless, it is accepted practice to utilize prophylactic cephalosporin. There is a

connection in between the antimicrobial vulnerabilities of germs isolated from the lung prior to lung resection, the prophylactic antimicrobial used, and the event of postoperative infection*(Boldt J et al.,1999)*. Antimicrobial prophylaxis is not indicated for chest tube insertion to deal with nontraumatic conditions such as spontaneous pneumothorax however is shown for closed-tube thoracostomy after major chest injury*(Gonzalez R et al.,1998)*.

Urologic

Prior to a lot of urologic procedures, prophylactic antimicrobials are not indicated for patients with sterile urine; however, preoperative sterilization of the urine is suggested for patients with indwelling urethral catheters or bacteriuria. A prophylactic antimicrobial is indicated prior to transrectal prostate biopsy*(Taylor H et al.,1997)*.A single dosage of ciprofloxacin works and commonly used; however, trimethoprim-sulfamethoxazole is similarly reliable*(Isen K et al.,1999)*.

Vascular procedures

Antimicrobial prophylaxis is not suggested for carotid endarterectomy or brachial artery repair; however, cephalexin decreases the occurrence of postoperative surgical website infection after arterial repair, and after vascular surgical treatments in the abdomen or legs*(Edwards WJ et al.,1993)*. The implantation of prosthetic product is a danger aspect for infection, and many practitioners use prophylactic antimicrobials for all vascular surgeries involving prosthetic product.

Bacterial Endocarditis

The rationale for antimicrobial prophylaxis

Endocarditis is an uncommon yet life-threatening infection. It generally takes place in individuals with unusual or prosthetic heart valves and requires bacteremia with organisms that can live on the valves. The source of the bacteremia can be inapparent or can be triggered by a focal infection such as cellulitis, an abscess, or pneumonia. Some surgical and dental procedures can produce short-term bacteremia, and, though the terrific bulk of endocarditis is not attributable to an intrusive treatment *(Strom B et al.,1998)*, periprocedure antimicrobials are administered to patients at risk with the objective of decreasing the threat for this major problem. Under the aegis of The American Heart Association, a panel of professionals has developed recommendations for making use of antimicrobial prophylaxis to reduce the danger of bacterial endocarditis after invasive

treatments *(Dajani et al1997)*. Despite these guidelines, antibiotic prophylaxis versus endocarditis is frequently both underused and worn-out*(Seto TB et al.,2000)*.

Table 2: Patient risk categories for endocarditis

High risk
Prosthetic valves, including bioprosthetic and homograft valves Prior endocarditis
Complex cyanotic heart disease
Surgically constructed systemic-pulmonary shunts
Moderate risk
Congenital cardiac malformations other than complex cyanotic heart disease
Rheumatic and other acquired, structurally abnormal valves
Hypertrophic cardiomyopathy
Mitral valve prolapse with a thickened or continuously regurgitant valve
Low risk (no greater risk than the general population)
Isolated secundum atrial septal defects
Surgically repaired: atrial septal defects, ventricular septal defects, or patent ductus arteriosus (more than 6 months after successful repair)
Prior coronary artery bypass
Implanted cardiac pacemakers and defibrillators
Prior Kawasaki's disease or rheumatic fever without valve dysfunction Mitral valve prolapse without a thickened or continuously regurgitant valve Benign murmurs

At risk patients

Patients at high threat for endocarditis include those with prosthetic valves, prior endocarditis, or complex cyanotic heart problem *(Table 2)*. Patients at moderate danger consist of those with hereditary heart malformations aside from complicated cyanotic cardiovascular disease; with rheumatic and other obtained structurally unusual valves; hypertrophic cardiomyopathy; and with mitral valve prolapse consisting of an abnormal, regurgitant mitral valve *(Table 2)*. Patients at no greater danger than the general population consist of those with separated secundum atrial septal flaws, surgically fixed atrial and ventricular problems (more than 6 months after successful repair), surgically repaired patent ductus arteriosus (more than 6 months after successful repair work), previous coronary artery bypass, implanted heart pacemakers and defibrillators, and benign whisperings *(Table 2).*

Aendodontistry, suture elimination, modification of orthodontic home appliances, endotracheal intubation, versatile bronchoscopy, tympanostomy, transesophageal echocardiography, and endoscopy without biopsy.

Lower genitourinary and gastrointestinal tract treatments associated with some threat of bacteremia include prostate surgery, cystoscopy, and urethral dilation. Treatments with negligible threat consist of vaginal hysterectomy, typical vaginal shipment, cesarean section, uterine dilation and curettage, therapeutic abortion, tubal ligation, insertion and elimination of intrauterine devices, and urethral catheterization *(Table 3).*

Table 3: Procedure risk categories for endocarditis in uninfected patients

Upper aerodigestive tract procedures with some risk of bacteremia
Procedures violating the oral, esophageal or intestinal mucosa, including:
Prophylactic cleaning with anticipated bleeding
Dental extractions and implants
Periodontal surgery, scaling, planing, and probing
Subgingival or intraligamentary periodontic manipulation or injection
Endodontic surgery beyond the apex
Initial placement of orthodontic bands, but not brackets
Tonsillectomy—adenoidectomy
Rigid bronchoscopy
Esophageal sclerotherapy and dilation
Biliary tract surgery including ERCP with biliary obstruction
Upper aerodigestive tract procedures with negligible risk of bacteremiaa
Restorative dentistry
Local anesthetic injection not into dental ligaments
Intracanal endodontistry
Suture removal
Adjustment of orthodontic appliances Endotracheal intubation
Flexible bronchoscopy

Tympanostomy tube insertion
Transesophageal echocardiography Gastrointestinal endoscopy with or without biopsy
Lower gastrointestinal and genitourinary tract procedures with some risk of bacteremia
Prostate surgery
Cystoscopy
Urethral dilation
Lower gastrointestinal and genitourinary tract procedures withnegligible risk ofbacteremi
Vaginal hysterectomy
Vaginal delivery
Cesarean section
Uterine dilation and curettage
Therapeutic abortion
Tubal ligation
Insertion and removal of intrauterine devices Urethral catheterization

Antimicrobials

Antimicrobials utilized in endocarditis prophylaxis are targeted at the most likely causative organisms *(Table 4)*. In upper aerodigestive system treatments, viridians (alpha-hemolytic) streptococci are the most likely causative organisms, and in lower gastrointestinal and genitourinary tract procedures enterococci (Enterococcus faecalis) are the most likely causative organisms. Oral amoxicillin or intravenous ampicillin is typically the antimicrobials of option. In upper aerodigestive system treatments, alternative antimicrobials for penicillin allergic patients consist of clindamycin, cephalexin, clarithromycin, cephadroxil, and azithromycin. Erythromycin is no longer listed as an alternative because of the accessibility of better-tolerated alternatives. In lower gastrointestinal and genitourinary tract procedures, vancomycin is the primary alternative to ampicillin. In the highest-risk patients going through lower genitourinary and gastrointestinal tract procedures, combination antimicrobial prophylaxis including gentamicin is utilized versus enterococci because enterococci are frequently resistant to antimicrobials.

Special considerations

Just like antimicrobial prophylaxis versus postoperative infection, prophylaxis against endocarditis would be expected to be most efficient if the antimicrobial is given within an hour prior to the treatment. Patients who chronically take antimicrobials, such as those who take penicillin for secondary prevention of rheumatic fever, might be colonized with bacteria resistant to penicillins. For these patients, it is appropriate to utilize an antimicrobial with a different system of action than the one taken chronically. For instance, for the patient who is taking penicillin to prevent rheumatic fever, either clindamycin or azithromycin would be a proper option.

· Summary

The primary prophylactic measure against postoperative infection is antiseptic technique in patient preparation, during surgery, and in postoperative patient care. Because the expected benefit of antimicrobial treatment is less than the risk of an adverse medication reaction, antimicrobial prophylaxis against postoperative infection is not indicated for procedures with a low infection rate. Antimicrobial prophylaxis has been demonstrated to be of greater benefit than risk in some procedures with higher infection rates; however, because the problem is complex and the data are limited, extrapolating these findings to the practitioner's setting and the individual patient remains a challenge *(Table 1).*

Antimicrobial prophylaxis for bacterial endocarditis is not effective for most patients, the seriousness of the potential infection has driven the creation of guidelines recommending prophylaxis for at-risk patients undergoing at-risk procedures. Applying these guidelines appropriately could help to reduce unwarranted use of antimicrobials.

In the prophylactic use of antimicrobials, as in many medical interventions, the difficulty is balancing the risks of the intervention with the potential benefits. Although we do not have either the randomized, controlled trials or the detailed, patient-specific information to estimate this balance precisely, there are general guidelines to help the clinician choose treatment for most patients.

Table 4: American Heart Association Recommendations for Endocarditis Prophylaxis

Upper Aerodigestive Tract Procedure with Some Risk of Bacteremia (Table 3)

High- or moderate-risk patient (Table 2)
No contraindication to penicillins:
Oral: amoxicillin 2 gm PO 1 hr prior to the procedure Intravenous: ampicillin 2 gm IV 1/2 hr prior to the procedure Penicillins contraindicated:
Oral: clindamycin 600 mg PO 1 hr prior to the procedure
or
cephalexin 2 gm PO 1 hr prior to the procedure
or
cephadroxil 2 gm PO 1 hr prior to the procedure
or
azithromycin 500 mg PO 1 hr prior to the procedure
or
clindamycin 500 mg PO 1 hr prior to the procedure
Intravenous: clindamycin 600 mg IV 1/2 hr prior to the procedure
or
cefazolin 1 gm IV 1/2 hr prior to the procedure
Lower gastrointestinal or genitourinary tract procedure with some risk of bacteremia (Table 3)
High Risk Patient (Table 2)
No Contraindication to Penicillins:
ampicillin 2 gm IV 1/2 hr prior to the procedure
Plus
Gentamicin 1.5 mg/kg IV 1/2 hr prior to the procedure
and, 6 hr later
Amoxicillin 1 gm PO, or ampicillin 1 gm IV Penicillins contraindicated:
vancomycin 1 gm IV 1.5 hr prior to the procedure
plus
Gentamicin 1.5 mg/kg IV 1/2 hr prior to the procedure Moderate-risk patient (Table 2)
No contraindication to penicillins:
Oral: amoxicillin 2 gm PO 1 hr prior to the procedure Intravenous: ampicillin IV 2 gm 1/2 hr prior to the procedure Penicillins contraindicated:
Vancomycin 1 gm IV 1.5 hr prior to the procedure

References

Annys E, Jorissen M. Short term effects of antibiotics (Zinnat) after endoscopic sinus surgery. Acta Otorhinolaryngol Belg 2000;54:23–8.

Antimicrobial prophylaxis in neurosurgery and after head injury. Infection in Neuro- surgery Working Party of the British Society for Antimicrobial Chemotherapy. Lancet 1994;344:1547–51.

Antimicrobial prophylaxis in surgery. Med Lett Drugs Ther 2001;43:92–7.

Arozullah A, Khuri S, Henderson W, et al. Development and validation of a multifactorial risk index for predicting postoperative pneumonia after major noncardiac surgery. Ann Intern Med 2001;135:847–57.

Boldt J, Piper S, Uphus D, et al. Preoperative microbiologic screening and antibiotic prophylaxis in pulmonary resection operations. Ann Thorac Surg 1999;68:208–11.

Boxma H, Broekhuizen T, Patka P, et al. Randomised controlled trial of single-dose antibiotic prophylaxis in surgical treatment of closed fractures: the Dutch Trauma Trial. Lancet 1996;347:1133–7.

Burke J. The effective period of preventative antibiotic action in experimental incisions and dermal lesions. Surgery 1961;50:161–8.

Callender D. Antibiotic prophylaxis in head and neck oncologic surgery: the role of gram- negative coverage. Int J Antimicrob Agents 1999;12:S21–5.

Calvo V, Borro J, Morales P, et al. Antifungal prophylaxis during the early postoperative period of lung transplantation. Valencia Lung Transplant Group. Chest 1999;115:1301–4.

Carrel T, Eisinger E, Vogt M, et al. Pneumonia after cardiac surgery is predictable by tracheal aspirates but cannot be prevented by prolonged antibiotic prophylaxis. Ann Thorac Surg 2001;72:143–8.

Chelmow D, Ruehli M, Huang E. Prophylactic use of antibiotics for nonlaboring patients undergoing cesarean delivery with intact membranes: a meta-analysis. Am J Obstet Gynecol 2001;184:656–61.

Cimochowski G, Harostock M, Brown R, et al. Intranasal mupirocin reduces sternal wound infection after open heart surgery in diabetics and nondiabetics. Ann Thorac Surg 2001;71:1572–8.

Classen D, Evans R, Pestotnik S, et al. The timing of prophylactic administration of antibiotics and the risk of surgical-wound infection. N Engl J Med 1992;326:281–6.

Coskun H, Erisen L, Basut O. Factors affecting wound infection rates in head and neck surgery. Otolaryngol Head Neck Surg 2000;123:328–33.

Da Costa A, Kirkorian G, Cucherat M, et al. Antibiotic prophylaxis for permanent pacemaker implantation: a meta-analysis. Circulation 1998;97:1796–801.

Dajani AS, Taubert KA, Wilson W, et al. Prevention of bacterial endocarditis. Recommendations by the American Heart Association. JAMA 1997;277:1794–801.

Dimick J, Lipsett P, Kostuik J. Spine update: antimicrobial prophylaxis in spine surgery: basic principles and recent advances. Spine 2000;25:2544–8.

Dobay K, Freier D, Albear P. The absent role of prophylactic antibiotics in low-risk patients undergoing laparoscopic cholecystectomy. Am Surg 1999;65:226–8.

Edwards WJ, Kaiser A, Tapper S, et al. Cefamandole versus cefazolin in vascular surgical wound infection prophylaxis: cost-effectiveness and risk factors. J Vasc Surg 1993;18:470–5.

Eggimann P, Pittet D. Infection control in the ICU. Chest 2001;120:2059–93.

Eiferman R, Snyder J, Nordquist R. Ciprofloxacin microprecipitates and macroprecipitates in the human corneal epithelium. J Cataract Refract Surg 2001;27:170–2.

Finkelstein R, Rabino G, Mashiah T, et al. Vancomycin versus cefazolin prophylaxis for cardiac surgery in the setting of a high prevalence of methicillin-resistant staphylococcal infections. J Thorac Cardiovasc Surg 2002;123:326–32.

Gillespie W, Walenkamp G. Antibiotic prophylaxis for surgery for proximal femoral and other closed long bone fractures. Cochrane Database Syst Rev 2001;CD000244.

Gonzalez R, Holevar M. Role of prophylactic antibiotics for tube thoracostomy in chest trauma. Am Surg 1998;64:617–20.

Gordon Y. Vancomycin prophylaxis and emerging resistance: are ophthalmologists the villains? The heroes? Am J Ophthalmol 2001;131:371–6.

Greif R, Akca O, Horn E, et al. Supplemental perioperative oxygen to reduce the incidence of surgical-wound infection. Outcomes Research Group. N Engl J Med 2000;342:161–7.

Group S-NC. Antibiotic prophylaxis in surgery: summary of a Swedish-Norwegian Consensus Conference. Scand J Infect Dis 1998;30:547–57.

Hebert P, Wells G, Blajchman M, et al. A multicenter, randomized, controlled clinical trial of transfusion requirements in critical care. Transfusion Requirements in Critical Care Investigators. Canadian Critical Care Trials Group. N Engl J Med 1999;340:409–17.

Higgins A, London J, Charland S, et al. Prophylactic antibiotics for elective laparoscopic cholecystectomy: are they necessary? Arch Surg 1999;134:611–3.

Isen K, Kupeli B, Sinik Z, et al. Antibiotic prophylaxis for transrectal biopsy of the prostate: a prospective randomized study of the prophylactic use of single dose oral fluoroquinolone versus trimethoprim-sulfamethoxazole. Int Urol Nephrol 1999;31:491–5.

Kamat A, Brancazio L, Gibson M. Wound infection in gynecologic surgery. Infect Dis Obstet Gynecol 2000;8:230–4.

Kaye K, Fraimow H, Abrutyn E. Pathogens resistant to antimicrobial agents. Epi- demiology, molecular mechanisms, and clinical management. Infect Dis Clin North Am 2000;14:293–319.

Kriaras I, Michalopoulos A, Turina M, et al. Evolution of antimicrobial prophylaxis in cardiovascular surgery. Eur J Cardiothorac Surg 2000;18:440–6.

Kulling D, Sonnenberg A, Fried M, et al. Cost analysis of antibiotic prophylaxis for PEG. Gastrointest Endosc 2000;51:152–6.

Kurz A, Sessler D, Lenhardt R. Perioperative normothermia to reduce the incidence of surgical-wound infection and shorten hospitalisation. Study of Wound Infection and Temperature Group. N Engl J Med 1996;334:1209–15.

Leal-Noval S, Rinco´ n-Ferrari M, Garc´ıa-Curiel A, et al. Transfusion of blood components and postoperative infection in patients undergoing cardiac surgery. Chest 2001;119:1461–8.

Li J, Markus P, Osmon D, et al. Reduction of vancomycin use in orthopedic patients with a history of antibiotic allergy. Mayo Clin Proc 2000;75:902–6.

Liesegang T. Perioperative antibiotic prophylaxis in cataract surgery. Cornea 1999;18: 383–402.

Mangram A, Horan T, Pearson M, et al. Guideline for prevention of surgical site infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. Am J Infect Control 1999;27:97–132.

McDonald M, Grabsch E, Marshall C, et al. Single- versus multiple-dose antimicrobial prophylaxis for major surgery: a systematic review. Aust N Z J Surg 1998;68:388–96.

Nathens A, Marchall J. Selective decontamination of the digestive tract in surgical patients: a systemic review of the evidence. Arch Surg 1999;134:170–6.

Phillips E, Louie M, Knowles S, et al. Cost-effectiveness analysis of six strategies for cardiovascular surgery prophylaxis in patients labeled penicillin allergic. Am J Health Syst Pharm 2000;57:339–45.

Rodrigo J, Alvarez J, Gomez J, et al. Comparison of three prophylactic antibiotic regimens in clean-contaminated head and neck surgery. Head Neck 1997;19:188–93.

Salkind A, Cuddy P, Foxworth J. The rational clinical examination. Is this patient allergic to penicillin? An evidence-based analysis of the likelihood of penicillin allergy. JAMA 2001;285:2498–505.

Sawaya G, Grady D, Kerlikowske K, et al. Antibiotics at the time of induced abortion: the case for universal prophylaxis based on a meta-analysis. Obstet Gynecol 1996;87: 884–90.

Segreti J. Is antibiotic prophylaxis necessary for preventing prosthetic device infection? Infect Dis Clin North Am 1999;13:871–7.

Seto TB, Kwiat D, Taira D, et al. Physicians' recommendations to patients for use of antibiotic prophylaxis to prevent endocarditis. JAMA 2000;284:68–71.

Shapiro M, Wald U, Simchen E, et al. Randomized clinical trial of intra-operative anti- microbial prophylaxis of infection after neurosurgical procedures. J Hosp Infect 1986;8: 283–95.

Sharma V, Howden C. Meta-analysis of randomized, controlled trials of antibiotic prophylaxis before percutaneous endoscopic gastrostomy. Am J Gastroenterol 2000; 95:3133–6.

Simons J. The role of topical antibiotic prophylaxis in patients undergoing contaminated head and neck surgery with flap reconstruction. Laryngoscope 2001;111:329–35.

Smetana G. Preoperative pulmonary evaluation. N Engl J Med 1999;340:937–44.

Solensky R, Earl H, Gruchalla R. Lack of penicillin resensitization in patients with a history of penicillin allergy after receiving repeated penicillin courses. Arch Intern Med 2002;162:822–6.

Strom B, Abrutyn E, Berlin J, et al. Dental and cardiac risk factors for infective endocarditis. A population-based, case-control study. Ann Intern Med 1998;129:761–9.

Tabbara K, al Jabarti A. Hospital construction-associated outbreak of ocular aspergillosis after cataract surgery. Ophthalmology 1998;105:522–6.

Tang R, Chen H, Wang Y, et al. Risk factors for surgical site infection after elective resection of the colon and rectum: a single-center prospective study of 2,809 consecutive patients. Ann Surg 2001;234:181–9.

Tanos V, Rojansky N. Prophylactic antibiotics in abdominal hysterectomy. J Am Coll Surg 1994;179:593–600.

Taylor H, Bingham J. The use of prophylactic antibiotics in ultrasound-guided transrectal prostate biopsy. Clin Radiol 1997;52:787–90.

Tenney J, Vlahov D, Salcman M, et al. Wide variation in risk of wound infection following clean neurosurgery. Implications for perioperative antibiotic prophylaxis. J Neurosurg 1985;62:243–7.

Tocchi A, Lepre L, Costa G, et al. The need for antibiotic prophylaxis in elective laparoscopic cholecystectomy: a prospective randomized study. Arch Surg 2000;135: 67–70.

Upadhyay M, Karmacharya P, Koirala S, et al. The Bhaktapur eye study: ocular trauma and antibiotic prophylaxis for the prevention of corneal ulceration in Nepal. Br J Ophthalmol 2001;85:388–92.

Van den Berghe G, Wouters P, Weekers F, et al. Intensive insulin therapy in critically ill patients. N Engl J Med 2001;345:1359–67.

Waddell T, Rotstein O. Antimicrobial prophylaxis in surgery. Committee on Antimicrobial Agents. Canadian Infectious Disease Society. CMAJ 1995;151:925–31.

Weber R. Wound infection in head and neck surgery: implications for perioperative antibiotic treatment. Ear Nose Throat J 1997;76:790–1.

Wieck J, Jackson J, O'Brien T, et al. Efficacy of prophylactic antibiotics in arthroscopic surgery. Orthopedics 1997;20:133–4.

Wong J, Torella F, Haynes S, et al. Autologous versus allogeneic transfusion in aortic surgery: a multicenter randomized clinical trial. Ann Surg 2002;235:145–51.

Yerdel M, Akin E, Dolalan S, et al. Effect of single-dose prophylactic ampicillin and sulbactam on wound infection after tension-free inguinal hernia repair with polypropylene mesh. Ann Surg 2001;233:26.

Young R, Lawner P. Perioperative antibiotic prophylaxis for prevention of postoperative neurosurgical infections. A randomized clinical trial. J Neurosurg 1987;66:701–5.