In the preantibiotic era, prevention of postoperative infections concentrated on aseptic surgical techniques and modifications of surgical procedures. After the introduction of antibiotics into clinical medicine, surgeons began administer antibiotic prophylaxis to decrease the incidence of infection, particularly wound infections. It is important to weigh these benefits against the emergence of antimicrobial resistance causing superinfections in addition to the potential risk of toxic and allergic reactions.

**BASIC RULES FOR ANTIMICROBIAL PROPHYLAXIS IN SURGERY**

1) **Consider the pathogens peculiar to the surgical site**
   The surgeon must know the pathogens common and peculiar to the site of surgery to select proper antibiotic therapy. For example, surgery of the large intestine requires prophylaxis against *E. coli* and *Bacteroides (B.) fragilis* but not *Staphylococcus (S)* and *Streptococcus*, whereas, cardiac surgery calls for appropriate coverage against *S. aureus*, but not *B. fragilis*. An antibiotic that has no effect against the organisms commonly found at the site of surgery is a frequent cause of failure.

2) **Antibiotic should reach the site of surgery in a concentration adequate to inhibit common pathogens**
   A surgeon should be familiar with the pharmacokinetics of commonly used antibiotics. For example, aminoglycoside like gentamicin known to be effective against *E. coli* become ineffective when the biliary tract is obstructed. Only negligible amounts of aminoglycosides are excreted into the bile. But, aminoglycosides can be used for prophylaxis in gallbladder surgery if the bile duct is patent. Although, penicillins like ampicillin, amoxicillin and cephalosporins like cephalothin, cefazolin, cefotaxime are in low concentration, (when the biliary duct is obstructed), it is high enough to inhibit the growth of Gram negative bacteria found in the biliary tract obstruction. Quinolones are ideal for surgical prophylaxis in biliary tract surgery because their concentrations in bile are not influenced by duct obstruction.

3) **Timing of antibiotic administration**
   The antibiotic must be present at the site of surgery before the incision is placed and therefore the timing of initiating antibiotic therapy is important. If antibiotic prophylaxis is started during the postoperative or intraoperative period the postoperative infection rate remains high. The ideal time appears to be about an hour before placing the incision [1]. We encourage giving the second dose during surgery because most antibiotics achieve the highest tissue concentrations after the second or the third dose but not after the first dose [2].

4) **Duration**
   Antimicrobial prophylaxis should be of short duration. A single dose or two to three doses are enough for prophylaxis. The choice is arbitrary and it is unrelated to the half life of the antibiotic used. Prolonged use of antibiotic prophylaxis encourages infections secondary to the antibiotic resistant bacteria.

5) **How many antibiotics are needed?**
   A well chosen single antibiotic is more effective than multiple antibiotics [3]. Addition of second antibiotics do not correct the inherent defect in the first antibiotic chosen. Polyantibiotic therapy causes more adverse effects.

6) **Select the least toxic antibiotic**
   Patients with poor renal function as well as elderly subjects should not be given potentially nephrotoxic antibiotics. Similarly, those with
poor liver function and those with a tendency to bleed, should not be given potentially hepatotoxic and coagulopathic antibiotics. Combination of any two beta-lactam antibiotics should be avoided as they tend to enhance coagulopathy [2].

7) Knowledge of antibiotic susceptibility of pathogens peculiar to your hospital
Indiscriminate use of broad spectrum antibiotics to prevent hypothetical pathogens is the cause for life-threatening multidrug resistant organisms in surgical units. Excessive use of any given antibiotic breeds bacteria resistant to the that antibiotic.

8) Avoid expensive antibiotics
If the infection can be prevented with a first generation cephalosporin, then do not use the third generation cephalosporin. Such logic should be used for all antibiotics selected to save medical costs.

9) Consider the special circumstances of the patient
A patient operated for abdominal trauma who also has head trauma if treated with metronidazole + gentamicin (an excellent combination for prophylaxis against abdominal pathogens) can develop Staphylococcal meningitis because gentamicin does not enter the CSF and metronidazole which enters the CSF is ineffective against S. aureus. Elderly patients who in general are on multiple drugs for diabetes, hypertension, depression etc. may need dose adjustments of the antibiotic used. All immunocompromised patients regardless of the site of surgery must be protected against serious pathogens like Pseudomonas. Diabetes mellitus patients should receive antibiotics effective against S. aureus, a common commensal among diabetics. All patients who have indwelling or implants of foreign bodies require antimicrobial prophylaxis when they undergo surgical procedures.

ORTHOPEDIC SURGERY

A fracture without an open wound needs no antibiotic, but those with open wounds require it [4]. Implantation of prosthetic devices such as joint replacement or internal fixations need antistaphylococcal antibiotics for prophylaxis to prevent both early and delayed onset of infections. First of all any antibiotic used in orthopedic surgery should cover S. aureus, a common skin bacteria. Secondly, all prosthetic implants require antibiotic coverage against S. epidermidis infection [5]. Vancomycin is the most effective drug against S. epidermidis. Routine prophylaxis can be provided by giving the first or second generation cephalosporins like cephalothin, cefazolin, cephradine or cephap group of drugs like cefoxitin, cefotetan or cefuroxime. The first dose should be given one hour before surgery and the last dose to be given on the day after surgery. Instead, some prefer to give only a single dose of antibiotic. The third generation cephalosporins and aminoglycosides are not as effective against S. aureus as the first generation cephalosporins. Despite high serum levels achieved by cephalosporins the bone concentrations are usually about 10 percent of the observed serum levels. Therefore at least three doses of these antibiotics are recommended. On the other hand, the bone concentrations of certain antibiotics like clindamycin, doxycycline, and quinolones are high, but these antibiotics are not recommended for prophylaxis because they are bacteriostatic but not bactericidal like penicillins and cephalosporins are. Unlike those who have prosthetic heart valves, patients with prosthetic joint implants do not need antimicrobial prophylaxis for dental or genitourinary tract surgery or any other surgical procedures.

The infection rate in orthopedic surgery increases proportionate to severity of associated trauma to the muscles, vessels and loss of soft tissue, S. aureus being the most common pathogen. Occasionally, it is complicated by Gram negative bacilli like Klebsiella, Serratia, Enterobacter as secondary pathogens. Therefore, routine use of quinolones is not recommended for prophylaxis, because of emergence of quinolone resistant bacteria. Quinolones are very useful in the treatment of osteomyelitis due to Gram negative bacteria but we do not recommend quinolone to treat Pseudomonas infection. Quinolones should not be used for the prevention or treatment of S. aureus infections. We neither recommend soaking of prosthetic joints or internal fixation hardware materials nor irrigate the surgical wounds routinely with any antibiotic solutions. They are of dubious significance, at their best causing higher incidence of hospital acquired infections. However, it is an accepted practice to administer antibiotic powders for revision of hip and knee orthoplasties in patients with previous history of sepsis [6].
Table 1 - Antimicrobial prophylaxis in surgery.

<table>
<thead>
<tr>
<th>Surgical site</th>
<th>Predominant pathogens</th>
<th>Antibiotic of choice</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stomach</strong> (normal)</td>
<td>Streptococcus</td>
<td>Cefazolin</td>
<td>Ampicillin Cefotaxime</td>
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<tr>
<td></td>
<td><em>Staphylococcus</em></td>
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<td></td>
<td><em>Lactobacilli</em></td>
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<tr>
<td></td>
<td>(in hypochlorhydria)</td>
<td>Anaerobes</td>
<td>Augmentin or Ampicillin with</td>
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<td></td>
<td></td>
<td>Gram Negative bacilli</td>
<td>Sulbactam or Metronidazole</td>
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<tr>
<td></td>
<td></td>
<td><em>Campylobacter pylori</em></td>
<td></td>
</tr>
<tr>
<td><strong>Small intestine</strong></td>
<td>Sterile or Few gram negative bacilli</td>
<td>Cefazolin</td>
<td>Cefotaxime Ceftazidime</td>
</tr>
<tr>
<td>(Duodenum, Jejunum)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Ileum or Obstructed</td>
<td>Aerobic and Anaerobic</td>
<td>Augmentin or Metronidazole or</td>
<td>Cefotaxime or Carbenicilllin or</td>
</tr>
<tr>
<td>small bowel)</td>
<td>Gram negative bacilli</td>
<td>Clindamycin with Gentamicin</td>
<td>Clindamycin with Gentamicin</td>
</tr>
<tr>
<td><strong>Colorectal</strong></td>
<td>Bacteroides fragilis</td>
<td>Metronidazole with Aminoglycosides</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Escherichia coli</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Appendix</strong></td>
<td>As above</td>
<td>Augmentin</td>
<td>Cefotaxime Ceftazidime</td>
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<tr>
<td></td>
<td></td>
<td>Carbenicillin</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Doxycycline</td>
<td></td>
</tr>
<tr>
<td><strong>Biliary Tract</strong></td>
<td>Escherichia coli</td>
<td>Augmentin</td>
<td>Cefotaxime Ceftizoxime</td>
</tr>
<tr>
<td></td>
<td>Salmonella</td>
<td>Cefazolin</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ciprofloxacin</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cefuroxime</td>
<td></td>
</tr>
<tr>
<td><strong>Esophagus</strong></td>
<td>Anaerobes</td>
<td>Clindamycin with Gentamicin or Augmentin</td>
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<tr>
<td></td>
<td><em>Gram positive cocci</em></td>
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<td></td>
</tr>
<tr>
<td><strong>Lung</strong></td>
<td>Gram negative</td>
<td>Cefazolin</td>
<td></td>
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<tr>
<td></td>
<td><em>Aerobic bacilli</em></td>
<td>Ciprofloxacin</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Anaerobes</em></td>
<td>Clindamycin with Aminoglycoside</td>
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<tr>
<td><strong>Cardiovascular</strong></td>
<td>S. aureus</td>
<td>Cefazolin</td>
<td></td>
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<tr>
<td>(without prosthesis)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(with prosthesis)</td>
<td>S. epidermidis</td>
<td>Vancomycin</td>
<td></td>
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<tr>
<td><strong>Prostate and other</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urological surgery</td>
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<td></td>
<td></td>
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<tr>
<td><strong>Orthopedic surgery</strong></td>
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<td></td>
<td></td>
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<tr>
<td>(without internal</td>
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<td>fixation or implants)</td>
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<td>implants)</td>
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</table>
| The above choices of antibiotics are based upon our practice and in vitro susceptibility patterns found at King/Drew Medical Center and they may not necessarily be the best choices for other medical centers.


**UROLOGICAL SURGERY**

Any antimicrobial used before prostatectomy, prostatic biopsy or transurethral resection of prostate should be effective against Gram negative bacilli because prostate enlargement is often associated with urinary tract infection due to Gram negative bacilli. Further, only antibiotics excreted by the kidney such as penicillins, cephalosporins, sulphonamides, aminoglycosides and quinolones are the preferred drugs. In contrast, macrolide antibiotics like erythromycin, lincomycin, clindamycin, azalides like azithromycin, clarithromycin or tetracyclines like minocycline or doxycycline are not recommended because they are not well excreted by the kidney. On the other hand, tetracyclines, macrolides and azalides are the drugs of choice for *Chlamydia prostatis* because these drugs (although not excreted by the kidney) tend to concentrate very well in the prostatic tissue at much higher than their serum levels. Carbenicillin and all quinolones concentrate well in the prostatic tissue and are well excreted by the kidney. Any antibiotic used for urological prophylaxis must be active against *E. coli*, *Klebsiella* and *Proteus* the most common bacteria responsible for 75 percent of these infections. One, two or three doses of ampicillin with or without sulbactam or amoxicillin with or without clavulanic acid, or quinolones like ofloxacin, levofloxacin, lomefloxacin or ciprofloxacin, trovafloxacin are the antibiotics of choice. They are as effective as the third generation cephalosporins. Infections associated with transurethral instrumentation such as urethral dilation, retrograde studies and lithoplexy may lead to urosepsis in 14 percent of the patients that could be prevented or decreased to less than 1 percent by proper antibiotic prophylaxis [7]. Immunocompromised patients such as those with diabetes mellitus, leukemia, AIDS or urogenital cancer require broad spectrum antibiotics to include other organisms like *Pseudomonas* and *S. aureus*. Such patients may benefit from drug combinations like a third generation cephalosporin along with an aminoglycoside.

**CARDIAC AND VASCULAR SURGERY**

Antibiotic prophylaxis is an universally accepted practice for cardiac surgery because of the serious risk of sternal or wound infection that may lead to wound dehiscence and life threatening infections, such as endocarditis and mediastinitis. The pathogens we are concerned about are *S. aureus* in wound or sternal infections and *S. epidermidis* for prosthetic valve or vascular graft. Additional pathogens include Gram negative bacilli such as *Serratia marcescens*, *Acinetobacter* or *Citrobacter* that may occur as contaminants from the pump oxygenator or acquired through various invasive monitoring devices used during the perioperative and intraoperative period. The most commonly used antibiotics for prophylaxis in cardiac and vascular surgery include the first or the second generation cephalosporins such as cephalothin, cefazolin, cefamandole or cefradine [11]. A single dose of these antibiotics appears to be as effective as multiple doses, provided that the serum antibiotic concentrations are maintained in the blood high enough to inhibit the growth of bacteria in the blood stream throughout the duration of surgery. The third generation cephalosporins have also been in use for this purpose. We do not use prophylaxis for implantation of permanent endocardial transvenous pacemak-
ers. However, prophylaxis may be necessary in centers that have a high incidence of infection and in cases where an emergency temporary pacemaker is being replaced by a permanent one. Vascular grafts require antimicrobial prophylaxis with agents active against *S. epidermidis* as well as *S. aureus* [5]. Cefazolin, a commonly used drug is effective on *S. aureus* but not *S. epidermidis* whereas vancomycin provides the best coverage for both organisms. The alternative less expensive drugs are amoxicillin + clavulanic acid or ampicillin + sulbactam but they are not as dependable as vancomycin.

### HEAD AND NECK SURGERY

Antimicrobial prophylaxis is indicated in cases of an incision through oropharyngeal mucosa, fractures communicating with oral cavity and for open reduction with internal fixation of maxillofacial injuries [15]. As expected prior radiation increases the risk of postoperative infections [16]. “Broad spectrum” antibiotics effective against both aerobic and anaerobic bacteria are recommended. They are penicillins like carbenicillin, mezlocillin, ticarcillin, ampicillin + sulbactam, amoxicillin + clavulanic acid, ticarcillin + clavulanic acid, piperacillin or third generation cephalosporins like cefotaxime, cefoperazone or ceftazidime. Alternatively, antimicrobial combinations like clindamycin + gentamicin, a semisynthetic penicillin + metronidazole or a quinolone with metronidazole are equally effective. Gentamicin ear drops may decrease the incidence of purulent otorrhea after placement of a typanostomy tube. Perioperative antibiotic prophylaxis for 24 hours is sufficient to prevent infection in clean and uncontaminated neck dissections [17].

### TRANSPLANT SURGERY

Prior usage of immunosuppressive drugs and polyantimicrobial therapy predispose transplantation patients to such hard to treat pathogens like pseudomonas, acinetobacter, citrobacter and other antibiotic resistant microbes. We recommend antibiotic selection based on the susceptibility patterns and the incidence of Gram negative pathogens prevalent at the institution of practice. The duration of therapy must be tailored to the individual need of the patient. Some institutions give routine amphotericin prophylaxis for fungal organisms but it is not always needed. For prophylaxis a combination of...
broad spectrum beta-lactam antibiotic can be given along with an aminoglycoside. The majority of infections are bacteria related to the surgical site or of nosocomial origin such as ventilators, intravenous cannulae. Nearly 45 to 100% of transplant recipients have cytomegalovirus which is dormant in most cases. Among fungal infections Candida albicans is amenable to amphotericin B or diflucan but Aspergillus infections are often resistant to these drugs and also fatal [18].

**GASTROINTESTINAL OPERATIONS**

The normal stomach harbors a small number (100 to 1000/ml) of Gram positive bacteria because of HCl secretion. In cases of hypochlorhydria such as when the stomach is full, when antacids are given, previous Billroth I or II surgery, atrophic gastritis, pernicious anemia or gastric cancer, there is bacterial overgrowth such as one to ten million organisms mostly Gram negative bacteria requiring antibiotic prophylaxis [2]. Gram negative bacilli are rare in the stomach of healthy North American or European adults but not so in countries with poor sanitary facilities. Ampicillin, amoxicillin, cephalothin or cefazolin seem ideal for gastric surgery prophylaxis but in cases of achlorhydria or previous gastric surgery, cefoxitin or cefotetan or carbenicillin, ampicillin + sulbactam, amoxicillin + clavulanic acid are preferred because they cover both aerobic and anaerobic gram negative bacilli. Again the duration for prophylaxis need not exceed 24 hours or three doses. Even a single dose may be enough for cases of percutaneous endoscopic gastrostomy [19].

*Helicobacter pylori,* a Gram negative aerobic bacillus is associated with gastric ulcer and cancer of the stomach [20]. Therefore when we operate for those conditions the antibiotic used should be effective against this organism. Macrolides like erythromycin, tetracyclines like doxycycline are most effective. However, if this organism is found in the surgical specimen long term antibiotic therapy is recommended. The small intestine, especially the duodenum and jejunum of nearly one half of healthy adults is normally sterile and therefore requires no routine antimicrobial prophylaxis for surgery of these sites [2]. However, surgery on distal ileum, or in patients with intestinal obstruction and intestinal stasis syndromes the antibiotic chosen must be effective against *Bacteroides fragilis.* Effective colo-rectal surgery is best managed with mechanical bowel preparation and non absorbable peroral antibiotics [21]. Active purgatives also diminish the bacterial burden in the colon. About ten billion bacteria (1 x 10^10) are found in a gram of feces, but dietary restrictions can decrease this number to 1 x 10^7/gram. The bowel preparation used for large bowel surgery in our hospital includes liquid diet in the evening (as an outpatient) and oral lavage solution consisting of a mixture of polyethylene glycol, KCl, NaHCO₃, and NaSO₄ marketed as GOLYTELY (Braintree Labs. MA); about five liters of this solution being ingested from 1 p.m. to 6 p.m. until the rectal effluent becomes clear. In addition they are given peroral antibiotics such as neomycin 2 g with metronidazole 2 g at 7 p.m. and 11 p.m. the night before surgery. Such regimen is as effective as cathartics or enemas given with peroral antibiotics. Additional coverage with intravenous antibiotics like ampicillin + sulbactam, amoxicillin + clavulanic acid may be given for a 24 hour period. However, the addition of these intravenous antibiotics failed to improve the already low incidence (5 percent) of intra abdominal sepsis achieved by the administration of Golytely (or Golyte) and peroral antibiotic regimen of erythromycin + neomycin [2, 21].

Biliary tract obstruction favors microbial colonization and overgrowth. As mentioned many antibiotics do not concentrate in the bile when the biliary tract is obstructed. For example, clindamycin, gentamicin and other aminoglycosides are normally excreted well into the biliary tract in high concentration. But, in cases of obstruction due to cholelithiasis the antibiotic levels were zero or negligible. Beta-lactam antibiotics and quinolones are also affected similarly. Gram negative aerobic bacilli are the most predominant pathogens associated with cholelithiasis and cholecystitis. Although (in our experience) anaerobes are rare but may occasionally be found. Cefazolin or ampicillin + sulbactam or amoxicillin + clavulanic acid are effective; alternatively, one to two doses of third generation cephalosporins like cefotaxime or cefoperazone are good choices. Indeed the first generation cephalosporins are as good as the second or the third generation cephalosporins. Quinolones such as ofloxacin, ciprofloxacin, lomefloxacin or trovafloxacin are just as effective as the third generation cephalosporins. A single dose of any of these antibiotic perhaps is as effective as multiple doses.
Normally, the pancreas is sterile, but when infected enteric Gram negative aerobes are involved they respond best to the first generation cephalosporins. For example, a single or three doses of cefazolin for one day is adequate for prophylaxis. If the surgical specimen yields bacteria on culture, antibiotic therapy should be prolonged and changed if necessary to appropriate antibiotics based upon the identification of the organism [2].

Usually, appendicitis is not associated with generalized peritonitis; E. coli and B. fragilis being the major pathogens. The antibiotics of choice are cefoxitin, cefotetan, ampicillin + sulbactam, amoxicillin + clavulanic acid or carbenicillin [2]. Either metronidazole or clindamycin can be chosen to cover for anaerobes and given along with an aminoglycoside or a quinolone. The decision to continue antibiotic therapy is based upon intraoperative findings of the severity of infection associated with appendicitis.

Abdominal trauma patients must receive antibiotics effective against both E. coli and B. fragilis; if not the septic fatality rate is high [22]. However, experience has set the limits for the duration of antibiotic therapy. If no injury to any hollow viscus is found at laparotomy, there is no need to give a second dose of the antibiotic. If the stomach, duodenum or jejunum is involved, we stop after the second dose. However, if the ileum is damaged a third dose is also given. In patients having large intestinal injuries we continue antibiotic therapy for five days.

Other investigators have shown that even in cases of large intestinal injury there is no need to continue antibiotic therapy beyond 24 hours. At present, metronidazole or clindamycin + an aminoglycoside is the standard therapy for abdominal trauma. We observed that a single antibiotic is adequate such as carbenicillin, cefamandole, cefoxitin, mezlocillin, piperacillin, ticarcillin, cefoperazone, ceftriaxone, cefotetan or cefizoxime without the addition of an aminoglycoside [3, 23].

How many antibiotics are necessary to treat abdominal trauma victims? To answer this question we did a prospective study in 219 patients of which 101 received a single drug, cefoperazone, 95 were given ceftriaxone with metronidazole and 95 received triple antibiotics, i.e., metronidazole along with gentamicin and ampicillin. We found no significant difference between these three antibiotic groups in terms of overall infection rate, duration of hospital stay and deaths.

However, there were higher incidence of non-infectious complications in the triple antibiotic group (P = 0.013). Our experience with thousands of patients with abdominal trauma suggests that it is unnecessary to add any antibiotic to cover against enterococcus [3]. We are convinced that a single most effective antibiotic is all that is needed to prevent infection in abdominal trauma victims regardless of the severity of trauma.

**FEMALE GENITAL TRACT SURGERY**

Normally the vagina and cervix harbor a variety of aerobic and anaerobic bacteria that require antimicrobial prophylaxis to prevent postoperative sepsis.

**OBSTETRICS AND CESAREAN SECTION**

In general antibiotics are contraindicated during pregnancy and therefore the current practice is to give the first dose of antibiotic soon after the umbilical cord is clamped. Published data clearly indicates that antibiotic therapy is required for ruptured membranes of 6 to 8 hours or before delivery because of the expected high incidence of postpartum infection such as endometritis, septicemia, pelvic abscess and wound dehiscence. However, it is unclear how long the therapy should be given. Some prefer a single dose and others recommend three doses or even three days of treatment. Cefazolin or ampicillin are the most commonly used antibiotics and they have decreased the occurrence of endometritis from 53% to 16 to 20% in cases of cesarian section [24].

Cepham group of antibiotics like cefotetan, cefmetazole as well as cefoxitin are also effective when given in a single dose [25]. Augmentin (amoxicillin + clavulanic acid) or Unasyn (ampicillin + sulbactam) appear to be better than ampicillin because they unlike ampicillin are known to be highly effective on anaerobic bacteria as well [24].

A word of caution is that regardless of the antimicrobial regimen used postoperative infection rate in cases of Cesarian section is directly proportionate to the number of vaginal examinations done during delivery. In fact, six examinations reportedly nullified any advantage derived from prophylactic antibiotics [24].
HYSTERECTOMY

Normally, the endometrium and the fallopian tubes are sterile but the cervix harbors both aerobic and anaerobic bacteria. Therefore, the least infection rate is in partial abdominal hysterectomy (cervix saved) and the highest incidence of infection being associated with total vaginal hysterectomy (cervix included). A variety of antibiotics like ampicillin or amoxicillin with beta-lactamase inhibitors (Augmentin, Unasyn) or alternatively the second (cefazolin) or third generation cephalosporins (cefoperazone, cefetazidine), cephagd drugs like cefoxitin or cefotetan are in use for prophylaxis. Minocycline, doxycycline are also effective in addition to certain quinolones like ciprofloxacin, ofloxacin, levofloxacin and others [26, 27]. Whereas the antibiotics decrease the bacterial counts from the vagina and thereby decrease the chances for post-operative sepsis at the site of surgery (incision site) they may not decrease the chances for urinary tract infection that can occur due to indwelling catheters during the postoperative period [26]. There seems to be no difference in the infection rate whether the vaginal vault is left open or closed provided they receive prophylactic antibiotics [27]. Also no difference in post-operative sepsis observed whether or not the patients had vaginal scrubbing or abdominal scrubbing with or without 10% providone-iodine (Betadine) immediately prior to the operation [28].

SOFT TISSUE INJURY

Simple lacerations that are closed within four hours of injury and are not associated with tissue loss can be cleaned and sutured without antimicrobial therapy. However, more complex lacerations, extensive contaminated wounds, blast injuries or high-velocity missile wounds need expert judgement for proper management and require antibiotic therapy.

When only the skin is breached, antimicrobials effective against staphylococci and streptococci is adequate, but when the injury is to the groin, axilla or the perineum the important principles to be observed are adequate debridement, frequent dressing changes and delayed primary or secondary closure.

Heavily contaminated wounds require adequate debridement until the tissue margins are viable. Inadequate tissue debridement cannot be compensated for, by any antibiotic. The most common pathogens for this situation are staphylococci and streptococci. However, E. coli, Enterococcus and Pseudomonas can occur as secondary invaders.

Occasionally, other pathogens like B. fragilis and anaerobic streptococci may be involved. Therefore, antimicrobials effective against staphylococcus and streptococcus are usually adequate, but when anaerobic infection is suspected appropriate antibiotics for anaerobes should be used.

Key words: antibiotic prophylaxis, surgery.

Acknowledgement

We thank Ms. Corine Clark, Administrative Associate of the Division of Gerontology and Geriatrics for preparation of this manuscript for publication.

We thank Ms. Mina R. Mandal, Director of Medical Library Services, Orthopedic Hospital, Los Angeles for literature search.

La scelta dell’antibiotico da utilizzare per la profilassi in chirurgia va fatta sulla base della localizzazione dell’intervento, dei potenziali agenti patogeni coinvolti, dell’efficacia in vitro, delle caratteristiche farmacocinetiche e dei costi del farmaco prescelto.

Ad esempio, un antibiotico da utilizzare per la profilassi della chirurgia cardiovascolare, ortopedica o della cute e dei tessuti molli dovrà necessariamente comprendere nel proprio spettro di attività lo Staphylococcus aureus ma anche le Enterobacteriaceae; le cefalosporine risultano in tal caso adeguate. Nel caso della chirurgia urologica, l’antibiotico da utilizzare dovrà evidentemente essere caratterizzato da un’escrezione per via renale in forma attiva, e dovrà essere efficace nei confronti di E. coli, un comune patogeno urinario. Riuscito utili in tale caso le penicilline e le cefalosporine. Antibiotici come macrolidi e tetracicline si concentrano nella prostata e pertanto risultano efficaci nella chirurgia prostatica ma, non essendo escreti per via renale, non sono di alcuna utilità nella profilassi uro-
Antimicrobial selection for prophylaxis in surgery is based on the site of surgery, likely pathogen involved in addition to the in vitro efficacy, pharmacokinetics and the cost of the drugs used. For example, prophylactic agent in cardiovascular or orthopedic and skin and soft tissue surgery must cover against Staphylococcus aureus as well as the enterobacteriaceae; cephalosporins being adequate. On the other hand, any drug used in cases of urologic surgery must be excreted by the kidney in an active state and should also be active against E. coli, a common uropathogen such as any cephalosporins or penicillin. Drugs like macrolides and tetracyclines accumulate in the prostate and are good for prostate surgery by they are not excreted well by the kidney and therefore useless for urological prophylaxis. It is important to note that even treating minor infections in a neurosurgical patient, we must use an antibiotic that cross blood-brain barrier otherwise meningitis might develop. In cases of gastrointestinal tract, surgery on the colon and appendix requires special coverage against anaerobic bacteria especially Bacteroides fragilis. On the other hand surgery on the stomach, gall-bladder and upper two thirds of small intestine, it is adequate to use drugs to cover aerobic bacteria such as E. coli. Most studies show that a single most effective antibiotic is enough and it is unnecessary to use two or more drug combinations.

SUMMARY

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