ANTIBIOTIC PROPHYLAXIS FOR SURGICAL PROCEDURES

Chapter 5

SUMMARY

SURGICAL PROCEDURE	PREDOMINANT INFECTING MICROORGANISM(S)	RECOMMENDED ANTIBIOTIC	DOSE	ROUTE
Cardiothoracic	Staphylococci	Cefazolin OR Cefuroxime (See text for alternatives *,**)	2 g 1.5 g	IV IV
Non-cardiac vascular surgery	Staphylococci	Cefazolin OR Amoxicillin/clavulanate	2 g 1.2 g	IV IV
Orthopaedic: Arthroplasty of joints, joint replacement	Staphylococci	Cefazolin (See text for alternatives *,**)	2 g	IV
Open reduction of fractures (grade 1 and 2)		Cefazolin OR Cefuroxime	2 g 1.5 g	IV IV
Lower limb amputation		Cefazolin OR Cefuroxime OR Amoxicillin/clavulanate	2 g 1.5 g 1.2 g	IV IV IV
Gastroduodenal	Streptococci, coliforms, anaerobic bacteria including Bacteroides spp.	Cefazolin	2 g	IV

SURGICAL PROCEDURE	PREDOMINANT INFECTING MICROORGANISM(S)	RECOMMENDED ANTIBIOTIC	DOSE	ROUTE
Biliary tract	Coliforms, enterococci, anaerobic bacteria including *Bacteroides*, clostridia	Cefazolin	2 g	IV
For high risk only:		OR		
> 70 years		Cefoxitin	2 g	IV
Obstructive jaundice		OR		
Acute cholecystits		Amoxicillin/clavulanate	1.2 g	IV
Acute cholangitis		(See text for alternatives ***)		
Common duct stone				
Low risk		Treat infection		
		No prophylaxis indicated		
Small intestine procedures and appendectomy	Coliforms, anaerobic bacteria including *Bacteroides fragilis*	Cefazolin **AND**	2 g	IV
		Metronidazole,	500 mg	IV
		OR		
		Cefoxitin	2 g	IV
Colorectal procedures	Coliforms, anaerobic bacteria including *Bacteroides fragilis*	Cefazolin **AND**	2 g	IV
		Metronidazole,	500 mg	IV
		OR		
		Cefoxitin	2 g	IV
		(See text for alternatives ***)		
Gynaecological:	Coliforms, enterococci, streptococci	Cefazolin	2 g	IV
Vaginal or abdominal hysterectomy		(See text for alternatives ***)		
Caesarean section (emergency, not indicated for routine Caesarean section)	As for hysterectomy	Cefazolin	2 g.	IV
Urological:	Coliforms	Ciprofloxacin	500 mg	PO
Lower tract instrumentation with risk factors for infection (including transrectal prostate biopsy)		OR		
		Levofloxacin	500–750 mg	PO
Prostatectomy	Coliforms	Ciprofloxacin	500 mg	PO
		OR		
		Levofloxacin	500–750 mg	PO
		OR		
		Gentamicin	240 mg	IV

SURGICAL PROCEDURE	PREDOMINANT INFECTING MICROORGANISM(S)	RECOMMENDED ANTIBIOTIC	DOSE	ROUTE
Clean urological surgery without entry into urinary tract	Staphylococci	Cefazolin	2 g	IV
Urological surgery with entry into gastrointestinal tract	Coliforms, anaerobic bacteria	Cefazolin **AND** Metronidazole OR Cefoxitin OR Ciprofloxacin OR Levofloxacin	2 g 500 mg 2 g 500 mg 500–750 mg	IV IV IV PO PO
CNS shunts	Staphylococci	Cefazolin	2 g	IV

* Deviations from these guidelines may be warranted in certain situations, e.g. known MRSA carriage in a patient undergoing emergency surgery where there is not sufficient time for mupirocin treatment and chlorhexidine baths, or during MRSA outbreaks in an individual hospital. However, this is no substitute for good infection control. In addition, there is no evidence that glycopeptides decrease infections and that glycopeptide prophylaxis is superior, even if the incidence of MRSA or multi-resistant-CoNS (coagulase-negative staphylococci) is high.

Options with MRSA/CoNS cover:

Vancomycin 15 mg/kg IV (max 2 g),

OR

Teicoplanin 400 mg–800 mg.

** For ß-lactam allergy in cardiac, vascular, hip or knee arthroplasty:

As above,

OR

Clindamycin 900 mg IV.

*** For ß-lactam allergy in biliary tract, colon or gynaecological surgery:

Clindamycin 900 mg **AND** gentamicin 240 mg IV,

OR

Clindamycin 900 mg **AND** ciprofloxacin 400 mg IV.

NOTE

Cefazolin should be given at dose of 3 g IV for patients weighing > 120 kg.

INTRODUCTION

Surgical site infections (SSIs) are a common cause of healthcare-associated infection. The CDC has defined a SSI as an infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure, or within 90 days if prosthetic material is implanted at surgery.

Despite evidence for its effectiveness and the publication of guidelines on antimicrobial prophylaxis to prevent SSIs, substantial inconsistencies occur in the use of prophylactic antibiotics and their duration, especially for patients undergoing major surgery, e.g. incorrect antimicrobial agents given, the agents are given too long before incision, and antibiotics are continued for days instead of the generally advised single prophylactic dose.

FUNDAMENTAL PRINCIPLES OF SURGICAL PROPHYLAXIS

- The goal of antimicrobial prophylaxis is to prevent surgical site infection by reducing the burden of microorganisms at the surgical site during the operative procedure.
- The antibiotic must be in the tissue before the bacteria are introduced, i.e. antibiotic must be given intravenously shortly before surgery to ensure high blood and tissue levels during the surgical procedure. Prophylaxis failure may be due to antibiotics given too late or more often, given too early before surgical incision. The half-life of the particular antibiotic used is therefore important.
- There is no data to support more than a single dose of antibiotic. Further doses generally constitute treatment. Note the waste of resources, the increased risk of complications and the fact that multiple doses are not associated with increased efficiency. Repeat dosing is however indicated if the procedure exceeds two half-lives of the drug, or if there is excessive blood loss (> 1500 mL).
- The chosen antibiotic must be active against the most common expected pathogens.
- High-risk patients, e.g. patients with jaundice or diabetics, or patients who undergo any procedures to insert prosthetic devices, generally warrant antibiotic prophylaxis.
- Good surgical technique is fundamental to lowering SSI rates. These techniques include gentle traction, effective haemostasis, removal of devitalised tissues, irrigation of tissues with saline during long procedures to avoid excessive drying, use of fine non-absorbed monofilament suture material, judicious use of closed suction drains and wound closure without tension.
- There is no convincing statistical differences in efficacy between the first- (cefazolin), second- (cefuroxime) or third-generation cephalosporins (ceftriaxone), therefore a first-generation cephalosporin with the narrowest spectrum of activity is often the recommended option.
- Most patients with a penicillin allergy can be given a cephalosporin, since allergic reactions to cephalosporins are infrequent except in patients with severe IgE-mediated reactions to penicillins, e.g. anaphylaxis.

FOR WHICH OPERATION IS PROPHYLAXIS INDICATED?

A widely accepted classification system was developed based on the expected degree of microbial contamination during surgery. It stratified wounds as clean, clean-contaminated, contaminated or dirty and there is a correlation between the type of wound and the surgical site infection rate. Antibiotic prophylaxis is generally indicated for surgical procedures with a higher rate of infection:

- All clean-contaminated procedures where a viscus is entered under controlled conditions. These include penetration of the gastrointestinal tract, whether by penetrating trauma or related to a pathological organ event (e.g. ruptured appendix, perforated colonic diverticulum) prior to the development of clinical peritonitis.

- Clean operations with foreign body implants (e.g. vascular, cardiac and orthopaedic operations), and those without foreign body implants, especially hernia repair, breast surgery, median sternotomy, vascular surgery involving the aorta and the lower extremities, and craniotomies.
- The use of antibiotics in operations classified as contaminated or dirty/infected should be considered as therapeutic and antibiotics should be given for a longer duration. Operations for acute cholecystitis, empyema of the gall bladder, ascending cholangitis or liver abscess require antibiotic treatment rather than prophylaxis. The same applies to operations for a perforated appendix with evidence of localised or generalised peritonitis and/or intra-abdominal abscess, and penetrating abdominal trauma where significant gastrointestinal leakage with peritoneal soiling is identified at the time of operation.

TIMING OF ANTIBIOTIC PROPHYLAXIS

- Current recommendations are that the parenteral antibiotics used in prophylaxis should be started, in sufficient dosages, within 30–60 minutes of the surgical incision. This results in near maximum drug levels in the wound and the surrounding tissues during the operation. Vancomycin and fluoroquinolones may require one to two hours infusion time, thus they should be given two hours before surgical incision.
- SSIs increase 6-fold if antibiotics are administered longer than two hours pre-operatively or for more than three hours post surgery.
- The incidence of SSIs with administration 30–60 minutes pre-surgery has been documented as ~1.3% vs. ~4–6% ($p < 0.0001$) when administered earlier or later. The appropriate timing of prophylaxis can be facilitated by having the anaesthetist administer the antibiotic in the operating room when the intravenous lines are inserted shortly before operative incision.

ROUTE OF ADMINISTRATION OF PROPHYLACTIC ANTIBIOTICS

- Unless otherwise stated, all antibiotic recommendations in this guideline imply intravenous administration of the prophylactic antibiotic.
- Oral agents currently play a role only in the preparation of patients before elective colon surgery or some high-risk patients undergoing urological procedures.

ANTIBIOTIC PROPHYLAXIS FOR COMMON SURGICAL OPERATIONS

CARDIAC, THORACIC AND VASCULAR SURGERY

Antibiotic prophylaxis in cardiovascular surgery has proven beneficial only for the following procedures:

- Reconstruction of the abdominal aorta.
- Procedures on the leg which involve a groin incision.
- Any vascular procedure with insertion of a prosthesis/device.
- Lower extremity amputation for ischaemia.
- Cardiac surgery, including insertion of permanent pacemakers and heart transplants.

CARDIAC: PROSTHETIC VALVE INSERTION, CORONARY ARTERY BYPASS GRAFT, OTHER OPEN HEART SURGERY, PACEMAKER IMPLANT, MEDIAN STERNOTOMY

Cefazolin 2 g IV

OR

Cefuroxime 1.5 g IV

NOTE

For patients undergoing cardiac procedures, the recommended regimen is a single pre-incision dose of cefazolin or cefuroxime with appropriate intraoperative re-dosing for procedures longer than three hours. Currently there is no evidence to support continuing prophylaxis until all drains and indwelling catheters are removed.

NON-CARDIAC VASCULAR: E.G. AORTIC RESECTION, PROSTHESIS, GROIN INCISION, LOWER EXTREMITY AMPUTATION

Cefazolin 2 g IV

OR

Cefuroxime 1.5 g IV

NOTE

During prolonged operations longer than three hours, additional intra-operative doses are indicated. The value of antibiotics in carotid or brachial artery surgery has not been established, unless prosthetic material is used. To cover for Gram-negative coliform bacteria during groin incisions, a second-generation cephalosporin such as cefuroxime may be preferred, only if high rates of resistance to cefazolin are present in a specific community.

GENERAL THORACIC: PULMONARY, OESOPHAGEAL

Cefazolin 2 g IV

OR

Cefuroxime 1.5 g IV

NOTE

No clear consensus on the duration of antimicrobial prophylaxis has been established. Some authors recommend continuing the antibiotic for up to 48 hours after the procedure to prevent empyema or pneumonia.

ORTHOPAEDIC SURGERY

ARTHROPLASTY OF JOINTS, AND/OR JOINT REPLACEMENT

Cefazolin 2 g IV

NOTE

- For arthroplasty or internal fixation devices where infection rates are $< 5\%$, a single dose of cefazolin 2 g IV 30–60 minutes pre-incision, is recommended. If the operation is longer than three hours, a second dose should be given.
- The duration of prophylaxis for joint replacement procedures has been controversial. More recent data and clinical practice guidelines do not support prophylaxis beyond 24 hours.

OPEN REDUCTION OF CLOSED FRACTURE: GRADE 1 AND GRADE 2 TO BE HANDLED SIMILARLY TO OTHER CLEAN ORTHOPAEDIC PROCEDURES

Cefazolin 2 g IV

OR

Cefuroxime 1.5 g IV

NOTE

- For open reduction of closed fractures, a single dose of antibiotics at the time of surgical repair is adequate.
- In centres with infection rates > 5% and in open fractures grade 1 or 2, 24–48 hours prophylaxis is warranted i.e. above options given eight hourly.
- With fixation of grade 3 open fractures there is often extensive surgical site contamination. Use cefuroxime 2 g IV eight hourly; alternatively amoxicillin-clavulanate 1.2 g IV eight hourly for three to five days.

LOWER LIMB AMPUTATION

Cefazolin 2 g IV

OR

Cefuroxime 1.5 g IV

OR

Amoxicillin-clavulanate 1.2 g IV

NOTE

- For amputations complicated by infection or gangrene, or diabetic patients, antibiotics may be continued into the post-operative period and adjusted with wound culture results.
- Clindamycin 900 mg IV may be used for ß-lactam allergic patients.

ARTHROSCOPIC SURGERY

Data regarding prophylactic antibiotics is limited. A retrospective comparative study found no value in prophylactic antibiotics for knee arthroplasty.

LAMINECTOMY, SPINAL FUSION

Prophylactic antibiotics have not been proven to be beneficial.

GASTROINTESTINAL TRACT SURGERY

GASTRODUODENAL SURGERY

Antibiotics are indicated for high-risk patients only, i.e. patients with bleeding ulcers, obstructive duodenal ulcers, decreased gastric acidity (e.g. receiving acid suppression therapy), decreased GI motility, malignancy or morbid obesity.

GASTRODUODENAL SURGERY: HIGH RISK PATIENTS

Cefazolin 2 g IV

Clindamycin 900 mg IV may be used for ß-lactam allergic patients

BILIARY TRACT SURGERY

Most studies show that achieving adequate drainage will prevent post-procedural cholangitis or sepsis and there is no further benefit from prophylactic antibiotics. With inadequate drainage, antibiotics may be of value. The American Society for GI Endoscopy recommends prophylaxis for known or suspected biliary obstruction.

BILIARY TRACT SURGERY: KNOWN OR SUSPECTED OBSTRUCTION

Cefazolin 2 g IV

OR

Cefoxitin 2 g IV

OR

Amoxicillin-clavulanate 1.2 g IV

NOTE

- The cephalosporins are not active against the enterococci, yet are clinically effective as prophylaxis in biliary surgery.
- For patients with cholangitis, treat the infection and do not use prophylactic antibiotics.
- High-risk patients include those > 70 years of age, those with acute cholecystitis, a non-functioning gall bladder, obstructive jaundice or common duct stones, gallbladder rupture and open cholecystectomy.
- Clindamycin 900 mg IV and ciprofloxacin 400 mg IV may be used for ß-lactam allergic patients.
- The value of prophylaxis for ERCP is controversial, however prophylaxis is recommended with obstruction.

INGUINAL HERNIA REPAIR

Available data is limited, routine prophylaxis is not recommended. For a mesh implant, however, prophylaxis is indicated, e.g. cefazolin or cefuroxime IV as a single dose.

COLON SURGERY

Prophylaxis consists of a combination of bowel preparation and antibiotics. Bowel preparation is however no longer routinely indicated for all colon surgery. It is still performed when there is a significant risk for major contamination during the operation and obviously still done as preparation for colonoscopy. It is recommended for pre-operative preparation before selected cases of elective colon surgery and terminal ileal surgery.

COLON SURGERY PROPHYLAXIS

Cefazolin 2 g IV **AND** metronidazole 500 mg IV

OR

Ceftriaxone **AND** metronidazole 500 mg IV

OR

Amoxicillin–clavulanate 1.2 g IV

NOTE

- For patients with a ß-lactam allergy, refer to summary table.***
- For non-elective colorectal surgery, give amoxicillin-clavulanate 1.2 g IV and then eight hourly for three doses.
- Enemas/suppositories are only used for patients not having full bowel preparation, e.g. haemorrhoid surgery.

APPENDECTOMY

For uncomplicated appendicitis:

Cefazolin 2 g IV **AND** metronidazole 500 mg IV

OR

Cefoxitin 2g IV

NOTE

For patients with ß-lactam allergy, refer to summary table.***

If the appendix is perforated, treat as an infection for three to five days.

PENETRATING ABDOMINAL TRAUMA

Any antibiotic cover can be considered as pre-emptive treatment and not as prophylaxis

Amoxicillin-clavulanate 1.2 g IV 8 hourly

NOTE

For patients with ß-lactam allergy, refer to summary table.***

Continue with amoxicillin-clavulanate for five days if intestinal perforation is present.

ABDOMINAL SURGERY NOT INVOLVING A VISCUS

Data to support recommendations for prophylaxis is not available.

OBSTETRICS AND GYNAECOLOGY

VAGINAL HYSTERECTOMY AND EMERGENCY CAESAREAN SECTION

Cefazolin 2 g IV

ABDOMINAL HYSTERECTOMY, CERVICAL CERCLAGE AFTER 18 WEEKS, INDUCED ABORTION WITH RISK FACTORS, (E.G. HISTORY OF PREVIOUS PID, MULTIPLE PARTNERS, YOUNG, KNOWN GONOCOCCAL OR CHLAMYDIA INFECTIONS) – ANTIBIOTIC PROPHYLAXIS IS PROBABLY INDICATED

Cefazolin 2 g IV

NOTE

For patients with ß-lactam allergy, refer to summary table.***

Prophylactic antibiotics are not indicated for cases of elective caesarean section.

Prophylactic antibiotics are not indicated for insertion of an IUCD.

UROLOGICAL SURGERY

Urological-specific risk factors include anatomic anomalies of the urinary tract, urinary obstruction and stones, indwelling or externalised catheters, pre-operative urinary tract infection (UTI).

PROSTATECTOMY

Prophylaxis is indicated only for high-risk patients such as those with uraemia, diabetes, a neurological bladder, large residual volume, cardiac disease, or previous UTI.

Ciprofloxacin 500 mg PO

OR

Levofloxacin 500–750 mg PO

NOTE

Aminoglycosides as a single IV pre-operative dose is an acceptable alternative.

TRANSRECTAL PROSTATE BIOPSY

Ciprofloxacin 500 mg PO 12 hours prior to biopsy and repeated 12 hours after the first dose

CYSTOSCOPY WITH MANIPULATION

Procedures include ureteroscopy, biopsy, fulguration

Ciprofloxacin 500 mg PO

NOTE

- Broader spectrum agents such as carbapenems are no more effective than fluoroquinolones and should be reserved as prophylactic agents for those patients undergoing prostatectomy or prostate biopsy and known to be colonised with or having an active infection with resistant pathogens such as ESBL positive Gram-negative organisms.
- Prophylactic antibiotics are not indicated for patients with sterile urine undergoing dilatation of the urethra, endoscopic diagnostic procedures without manipulation, needle biopsy or lithotripsy.
- Prophylaxis is indicated if a catheter has been present for > 24 hours.
- Ideally the catheter should be inserted two hours or less, prior to surgery.
- If the urine is infected, it is preferable to sterilise it before an elective procedure.

HEAD AND NECK SURGERY

TONSILLECTOMY, ADENOIDECTOMY, SEPTOPLASTY, RHINOPLASTY

Data does not support antibiotic prophylaxis for these procedures.

MAJOR HEAD, NECK AND ORAL SURGERY

If incision is through oral or oropharyngeal mucosa:
Cefazolin 2 g IV **AND** metronidazole 500 mg IV
OR
Cefuroxime 1.5 g IV **AND** metronidazole 500 mg IV
OR
Amoxycillin-clavulanate 1.2 g IV

NOTE

For patients with ß-lactam allergy, refer to summary table.***

CLEAN HEAD AND NECK PROCEDURES

Prophylactic antibiotics are not required for clean, uncomplicated head and neck procedures.
If, however, prosthetic material is placed, use:
Cefazolin 2 g IV
OR
Cefuroxime 1.5 g IV