 DOI: 10.18231/2394-5478.2017.0026

Review on importance of antimicrobial prophylaxis and sterilization procedures in general surgery

Norah Saad J. Bin Saad

Senior Registrar, Dept. of General Surgery, King Fahd Medical City, Riyadh, KSA

Email: dr.noura@msn.com

Abstract

Antimicrobial agents are compounds which inhibit the growth, or kill microorganisms. Antimicrobial agents can be used for either treatment or prevention of infectious disease but must be used properly and accurately. The use of antimicrobials in the prevention of disease is called prophylaxis. There are four occasions when prophylactic antimicrobials are indicated and these are:

- When the risk of post-operative infection is high.
- When wounds are contaminated with soil or dirt (e.g. after road traffic accidents) and there is a risk of infection (e.g. *Clostridium tetani*).
- Where the consequences of infection are serious or life threatening.
- When a person's defences against infection are compromised.

Keywords: Antimicrobial prophylaxis (AP), Surgery, Surgical Site Infections (SSIs), Randomized Clinical Trials (RCTs), Infections.

Introduction

Antimicrobial prophylaxis is the fundamental application method of an antimicrobial agent meant to decrease the danger of post-procedural local and systemic infections.[1] Antimicrobial prophylaxis is generally practiced by clinicians for the prevention of many contagious diseases, involving herpes simplex infection, rheumatic fever, recurrent cellulitis, meningococcal disease, frequent uncomplicated urinary tract infections in women, spontaneous bacterial peritonitis in patients with cirrhosis, influenza, infective endocarditis, pertussis, and acute necrotizing pancreatitis, along with other infections related with open fractures, recent prosthetic joint placement, and bite wounds. Perioperative antimicrobial prophylaxis is suggested for different surgical methods to avoid surgical site infections (SSI).[2] SSIs are usually limited to the dissection site although can also develop inside deep adjacent structures. SSIs are the extremely prevailing and are expensive healthcare-related infections.[3] Surgical site infections nearly double the usual charge of treatment, and patients with SSIs are additionally expected to be readmitted, need stay in the intensive care unit, and suffer mortality.[4] Surgical site infections (SSIs) and postoperative urinary tract infections (UTIs) are a common cause of patient morbidity. Surgical site infections involve up to 5% of sterile extraabdominal operations and up to 20% of intraabdominal procedures.[5]

Fundamentals of Surgical Antimicrobial Prophylaxis

Antimicrobial prophylaxis is solely one of the various methods hopeful to decrease SSI. Rest of the other things contain bowel preparation, preoperative hair rip out, cleaning with antiseptic solution, practice of - cleaning hands, wearing double gloves, and arrangement of hygienic operative ground.[1]

The usual procedures like the practice of mechanical bowel preparation (MBP) and the rest can no more be essential. The proof of the indicated is a meta-analysis of randomized clinical trials (RCTs) examining MBP to no MBP following particular colorectal surgery produced no data to hold up the benefit of MBP in patients going through elective colorectal surgery.[6]

A study of RCTs measuring removing of hair with no hair removing, other approaches of hair removing, hair removing operated at separate occasions before surgery, and hair removing performed in various locations resolved that there was no change in SSIs amidst patients who got their hair removed preceding to surgery along with them who did not.[7]

A report of six RCTs comprising a total of 10,007 patients having surgery correlated the results of preoperative cleaning with antiseptic source to drenching with non-antiseptic elements. The antiseptic determinants added no use in conditions of decreasing the danger of SSI.[8]

Present day, application of liquid alcohol to hands has been come up with a possible choice to the conventional surgical hand washing. In a huge RCT representing 4,387 patients, the two solutions were established to be adequate in view to SSIs. Corresponding with hygiene protocol hand washing remains superior than application of liquid alcohol (44% versus 28%).[9]

There is no open confirmation that extra glove used for safety by the surgical group lessens surgical infection in the case.[10]

Clean construction of the operative area is the vital element of sterile surgical procedure. Numerous substances are active, containing ethyl alcohol, isopropyl alcohol, aqueous iodine topical solution, iodine tincture, povidone-iodine, and chlorhexidine gluconate. New investigations proposed towards the query of the skin scrub that it is normally carried out before the rub with a sterile substance. In a RCT of skin preparation for abdominal surgery, Ellenhorn and colleagues[11] identified that washing with povidone-iodine soap and proceeding with povidone-iodine was linked with no fewer SSIs than painting with povidone-iodine alone.[12]

So we can say that the methods linked to influence SSI involve period of surgery, procedure, kind of preoperative skin preparation, incomplete sterilization of surgical tools, duration of surgical wash, preoperative removing of hair, antimicrobial prophylaxis, operation-room aeration, low hemostasis, usage of surgical drains, foreign material in the surgical site, and tissue trauma.[13]

Hidden benefits and recommendations of AP

The possible advantage of antimicrobial prophylaxis is persistent by patient factors, operation factors, and the apparent morbidity of infection. Antimicrobial prophylaxis is suggested only when the possible asset dominates the danger and expected charges (along with the budget of agent and authority, threat of hypersensitive reactions or new antagonistic reactions, and analysis of bacterial resistance).[1] The extensive benefit of antibiotic prophylaxis for dental procedures, are cases that cause bleeding in the mouth, has turn into a general use among dentists. Antibiotic prophylaxis not only executes by eradicating bacteria, but also by preventing bacterial attachment.[14]

Therapeutics of antibiotic is necessary and crucial in medicine and dentistry. Penicillin is the excellent drug superior in medical dental infections. Patients at great possibility of infection contain those with infective endocarditis, immunocompromised conditions and dental procedures that can cause bacteremias. Invasive dental methods if operated in specific patients need to be lead with an antibiotic prophylaxis.[14] Antimicrobial prophylaxis (AP) can be used adequately to avoid infection; however its purpose should be confined to precise, well-approved implications to prevent too much expense, toxicity, and antimicrobial resistance. Antimicrobial prophylaxis can be expressed basically to stop an early infection or further avoid the return or reactivation of an infection, or it may also be controlled to stop infection by removing a colonizing organism.[15] In consideration of prophylactic antimicrobial administration to be excellently powerful, proper schedule and amount of antibiotic are important. Infusion of the first dose has to be introduced within 60 minutes of the surgical incision (with the exception of 120 minutes for intravenous fluoroquinolones and vancomycin). As with timing, appropriate amount of antibiotic is systematically necessary. Specific drugs should be modified according to the patient's body weight (or corrected dosing weight) or body mass index. Likewise other doses are prescribed intraoperatively if the procedure continous beyond two half-lives of the first dose.[5] Antimicrobial prophylaxis is regularly employed by clinicians to avoid various infectious diseases[2] such as

For Rheumatic Fever: The person that had an attack of rheumatic fever has extreme possibility of having recurrences after consequent GAS (Group- A Streptococcus) pharyngitis and requires constant antimicrobial prophylaxis to avoid similar recurrences (secondary prevention).[16]

For Recurrent Cellulitis: Antimicrobial prophylaxis may be a beneficial method to prevent lymphedema with local standards and at the same time in the cure of tinea pedis as avoiding to repetitive cellulitis.[17]

For Meningococcal disease: Antimicrobial prophylaxis for meningococcal diseases should be provided to close association of sporadic patients of *Neisseria meningitidis* infection.[18]

For Asplenic patients: Penicillin prophylaxis is approved in children at the time of their some early years following splenectomy to impediment overcoming *Streptococcus pneumonia* sepsis.[19]

For Urinary Tract Infections (UTIs): Patients that are allowed and need for prophylaxis with often UTIs comprise of pregnant women, individuals with spinal cord damage, individuals with neurogenic bladders, kidney transplant patients, and persons with chronic bacterial prostatitis.[20]

For Spontaneous Bacterial Peritonitis (SBP): In expected randomized clinical trials, initial prophylaxis is given to patients with higher possibility of infection and secondary prophylaxis next with the first episode of SBP have been proved to be strong in avoiding SBP.[21]

For Bite Wound Infections: Antimicrobial prophylaxis for bite wounds has currently been studied and considered to be given to gross patients who are hoped to acquire a high possibility of infection. All dog and cat bites are sustained to be properly intoxicated and debrided and rabies prophylaxis need to be conducted, if recorded. Immediate initial closing of highly effected wounds is required to be treated to reduce the chances of wound infection. Human bite wounds, consisting clenched fist injuries, are thought to have great possibility of infection with microbes such as *Streptococcus anginosus*, *S aureus*, *Eikenellacorrodens*, and anaerobes. Suggested AP is identical to that for animal bite wound.[22]

For Pertusis: Tdap-vaccinated health care specialists are also having quite chances of getting pertussis and should be advised for chemoprophylaxis after an indicative pertussis exposure, mainly supposing that they are probably to be exposed to a patient who have

chances of high pertussis, such as hospitalized neonates and pregnant women.[23]

For Infective Endocarditis: Infective endocarditis (IE) is almost an uncommon endocardial infection that can cause fatal problems and loss of life. Antimicrobial prophylaxis is studied to be beneficial for patients placed at maximum possibility of complexities from IE who go through invasive procedures of the respiratory tract that include incision or biopsy examination of the respiratory mucosa (e.g., tonsillectomy, adenoidectomy).[24]

For Prosthetic Joint Infections: Further recently (February 2009), the Patient Safety Committee of the American Association of Orthopedic Surgeons (AAOS) issued an Information Statement (IS) suggesting that "therapists look at antibiotic prophylaxis for entire whole joint replacement patients before to each invasive method that can lead to bacteremia.[25]

For Open Fractures: The latest Surgical Infection Society Guideline approved AP with an early-generation cephalosporin subsequent to open fracture until 24 to 48 hours following injury closure.[26] Few groups confirm to count gram-negative inclusion for class III open fractures.[27]

For Herpes Simplex Virus Infections: Commonly reocurring genital herpes simplex viral infections (>5-6 episodes per year) are responsive to prophylaxis with regular acyclovir (400 mg twice daily), famciclovir (250 mg twice daily), or valacyclovir (500-1000 mg once daily).[28]

For Influenza: Chemoprophylactic treatment is suggested for people who are at increase chances of influenza development and hospitalized patients, or patients dealing with difficult, increased illness.[29]

Medical colleges are actually ranked on 3 surgical AP administration standards with cardiothoracic, vascular, colon, hip/knee, and vaginal or abdominal hysterectomy surgeries: (1) the ratio of patients who have parenteral AP introduced within 1 hour to previous surgical incision, (2) the ratio of patients who are given an antibiotic agent particularly rational with the present proclaimed standards, and (3) the ratio of patients whose prophylactic antibiotic is ended within 24 hours after the ultimate operation (48 hours for cardiothoracic surgery.[30]

Surgical Wound Classification

Clean	Uninfected operative site, with basic skin closure.
Clean-contaminated	Access into respiratory, alimentary, reproductive, or urinary tracts.
Contaminated	New accidental bruises, large gap in sterile procedure, heavy spillage from gastrointestinal tract, or existence of acute but non-purulent inflammation at the operative site.
Dirty-infected	Old accidental wound with debilitated tissue or existence of clinical infection or perforated hollow viscus at the operative site. This definition signifies that agents of postoperative infection were existed at the operative site prior to surgery.

Adapted from reference Mangram[31]

Studies of AP on some Surgeries

Higuchi et al.[32] did a research to know the ability of one dose of AMP for avoiding of pre-operative disease in a sum of 788 patients going through urological surgery that consisted of 380 endoscopic conducive operations. They observed UTI in 12 (3.2%) and isolated infection in 1 (0.3%) patients at the end of endoscopic conducive operation. They reported that one dose administration of AMP was strong and beneficial for the inhibition of UTIs in endoscopic conducive methods.

Cohen MJ et al[33] did a research and proposed that antibiotic prophylaxis might be reasonable to cirrhotic patients having ascites and without gastrointestinal hemorrhage. Nine trials were involved in the report. Seven trials, considering antibiotics to test substance or no cure, were meta-analyzed. Standardized preferences in structure or broadcast is recommended by test reports. The randomization reports proposed that the chances that correct randomization took place in all tests is very little and the result of most test related structure was weak. The ratio of participants with spontaneous bacterial peritonitis differed between the trials from 15% to 50%. The estimated proportion risks (95% confidence interval) of spontaneous bacterial peritonitis and death among patients treated with antibiotics related to no treatment/placebo were 0.20 (0.11 to 0.37) and 0.61 (0.43 to 0.87). There were very little results of detrimental cases.

Postoperative wound sepsis is the highest occurring nosocomial disease in patients undergoing.[34] It is a vital reason of illness, causing a long period of hospitalization, high price of clinical care and difficulty to patients and their families. Animal research by Burke2 initially explained the experimental grounds for the perioperative use of antimicrobial agents in the treatment of surgical wound infection. Scientific approval strongly determined the ability of antibiotic treatment in avoiding wound infection.[35]

Conclusion

It is important to emphasize that surgical antibiotic prophylaxis is a help to, not an alternative for, good surgical technique. Antibiotic prophylaxis should be observed as one component of a valid policy for the control of healthcare associated infection. This review covers the general practice of antimicrobial prophylaxis by clinicians for the prevention of many diseases

through surgical site infection, the benefits of antibiotic prophylaxis and the general principles of antibiotic administration. Thus, prophylactic administration of antibiotics inhibits growth of contaminating bacteria and their adherence to prosthetic implants, thus reducing the risk of infection.

References

1. Wolf JS, Bennett CJ, Dmochowski RR, Hollenbeck BK, Pearls MS, Schaeffer AJ, "Best practice policy statement on urologic surgery antimicrobial prophylaxis" Journal of Urology (2008) 179, 1379-90.
2. Mark J. Enzler, Elie Berbari and Douglas R. Osmon, "Antimicrobial Prophylaxis in Adults" Mayo Clin Proc. (2011) 86(7), 686–701.
3. Lewis SS, Moehring RW, Chen LF, et al., " Assessing the relative burden of hospital-acquired infections in a network of community hospitals" Infect Control Hosp Epidemiol. (2013) 34, 1229-30.
4. Guggenbichler JP, Assadian O, Boeswald M and Kramer A, "Incidence and clinical implication of nosocomial infections associated with implantable biomaterials – catheters, ventilator-associated pneumonia, urinary tract infections" GMS Krankenhhyg Interdiszip (2011) 6, Doc18.
5. Bratzler DW, Houck PM and Surgical Infection Prevention Guideline Writers Workgroup, "Antimicrobial prophylaxis for surgery: an advisory statement from the National Surgical Infection Prevention Project" Am J Surg. (2005)189, 395-404.
6. Bucher P, Mermillod B, Gervaz P and Morel P, "Mechanical bowel preparation for elective colorectal surgery: a meta-analysis" Arch Surg. (2004) 139, 1359-64.
7. Tanner J, Woodings D and Moncaster K, "Preoperative hair removal to reduce surgical site infection" Cochrane Database Syst Rev (2006) 2.
8. Webster J and Osborne S, "Preoperative bathing or showering with skin antiseptics to prevent surgical site infection" Cochrane Database Syst Rev (2006) 2.
9. Parienti JJ, Thibon P, Heller R, Le Roux Y, von Theobald P, Bensadoun H et al., "Hand- rubbing with an aqueous alcoholic solution vs traditional surgical hand-scrubbing and 30- day surgical site infection rates: a randomized equivalence study" JAMA (2002) 288, 722-727.
10. Tanner J and Parkinson H, "Double gloving to reduce surgical cross-infection" Cochrane Database Syst Rev 2006; (3):CD003087.
11. Ellenhorn JD, Smith DD, Schwarz RE, Kawachi MH, Wilson TG, McGonigle KF et al., "Paint-only is equivalent to scrub-and-paint in preoperative preparation of abdominal surgery sites" J Am Coll Surg (2005) 201, 737-41.
12. Takalkar YP, Garale MN, Somasundaram S, Venkataramani K, Gothwal KN, Pandrowala SA, "Comparison of efficacy of chlorhexidine alcohol scrub and povidone iodine scrub in hand cleansing in elective clean surgery" Int Surg J (2016) 3, 1937-41.
13. Juan Lucas Poggio, "Perioperative Strategies to Prevent Surgical-Site" Infection. Clin Colon Rectal Surg. (2013) 26, 168–173.
14. C Ramu and TV Padmanabhan "Indications of antibiotic prophylaxis in dental practice- Review" Asian Pac J Trop Biomed (2012) 2, 749–754.
15. Peter A Ongom and Stephen C Kijjambu "Antibiotic Prophylaxis in Colorectal Surgery: Evolving Trends. Ongom and Kijjambu" J Mol Pharm Org Process Res (2013) 1.
16. Kumar RK and Tandon R, "Rheumatic fever & rheumatic heart disease: The last 50 years" Indian Journal of Medical Research (2013) 137, 643–658.
17. Robinson AJ, Vu1 M, Unglik GA, Varigos G, Scardamaglia L, "Australasian College of Dermatologists Abstracts Presented at the 49th Annual Scientific Meeting 14–17 May 2016 Perth, Western Australia" Australas J Dermatol, (2016) 57: 3–85.
18. Andrew Terranella, Susan E. Beekmann, Philip M. Polgreen, Amanda Cohn, Henry M. Wu, and Thomas A. Clark "Practice Patterns of Infectious Disease Physicians for Management of Meningococcal Disease" The Pediatric Infectious Disease Journal (2012) 31, e201-e212.
19. Price VE, Blanchette VS, Ford-Jones EL "The prevention and management of infections in children with asplenia or hyposplenia" Infect Dis Clin North Am (2007) 21, 697-710.
20. Sobel JD, Kaye D. Urinary tract infections. In: Mandell GL, Bennett JE, Dolin R, editors., eds. Mandell, Douglas, and Bennett's Principles and Practices of Infectious Diseases. Vol 1 7th ed. Philadelphia, PA: Churchill Livingstone Elsevier; 2010:957-985.
21. Chavez-Tapia NC, Barrientos-Gutierrez T, Tellez-Avila FI, Soares-Weiser K, Uribe M "Antibiotic prophylaxis for cirrhotic patients with upper gastrointestinal bleeding" Cochrane Database Syst Rev (2010) 9.
22. Moran GJ, Talan DA, Abrahamian FM "Antimicrobial prophylaxis for wounds and procedures in the emergency department" Infect Dis Clin North Am (2008) 22, 117-143.
23. Centers for Disease Control and Prevention (CDC) Advisory Committee on Immunization Practices (ACIP) Provisional recommendations for health care personnel on use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccine (Tdap) and use of post-exposure antimicrobial prophylaxis; January, 2011. Available from" https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6001a4.htm.
24. Wilson W, Taubert KA, Gewitz M, et al "Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group" Circulation (2007) 116, 1736-1754.
25. American Association of Orthopedic Surgeons (AAOS) Information statement: antibiotic prophylaxis for bacteremia in patients with joint replacements. http://www.aaos.org/about/papers/advistmt/1033.asp Accessed Feb 20, 2017.
26. Hauser CJ, Adams CA, Eachempath SR "Prophylactic antibiotic use in open fractures: an evidence-based guideline" *Surg Infect (Larchmt)* (2006) 7, 379-405.
27. William SH, Bonadies JA, Cachecho R, and Dorlac WC, "East Practice Management Guidelines Work Group: Update to Practice Management Guidelines for Prophylactic Antibiotic Use in Open Fractures". J Trauma (2011) 70, 751-75 4.
28. Workowski KA, Berman S "Centers for Disease Control and Prevention (CDC) Sexually transmitted diseases

treatment guidelines 2010" MMWR Recomm Rep (2010) 59, 1-110.
29. Fiore AE, Fry A, Shay D, Gubareva L, Bresee JS, Uyeki TM "Centers for Disease Control and Prevention (CDC) Antiviral agents for the treatment and chemoprophylaxis of influenza: recommendations of the Advisory Committee on Immunization Practices (ACIP)" MMWR Recomm Rep (2011) 60, 1-24.
30. Surgical Care Improvement Project; November, 2012. Available from: http://www.aha.org/aha/issues/Quality-and-Patient-Safety/scip.
31. Mangram AJ, Horan TC, Pearson ML, Silver LC and Jarvis WR, "Guideline for prevention of surgical site infection, 1999. Hospital Infection Control Practices Advisory Committee" Infect Control Hosp Epidemiol (1999) 20, 250.
32. Higuchi Y, Takesue Y, Yamada Y, Ueda Y, Suzuki T, Aihara K, et al., "A single-dose regimen for antimicrobial prophylaxis to prevent perioperative infection in urological clean and clean-contaminated surgery" J Infect Chemother (2011) 17, 219-23.
33. Cohen MJ, Sahar T, Benenson S, Elinav E, Brezis M, Soares-Weiser K, "Antibiotic prophylaxis for spontaneous bacterial peritonitis in cirrhotic patients with ascites, without gastro-intestinal bleeding" Cochrane Database Systemic Rev (2009) 2, CD004791.
34. Dhar H, Al-Busaidi I, Rathi B, Nimre EA, Sachdeva V, Hamdi I, "A Study of Post-Caesarean Section Wound Infections in a Regional Referral Hospital, Oman" Sultan Qaboos Univ Med J (2014) 2.
35. de Oliveira JC, Martinelli M, Nishioka SA, Varejao T, Uipe D, Pedrosa AA, Costa R, D'Avila A, Danik SB, "Efficacy of Antibiotic Prophylaxis Before the Implantation of Pacemakers and Cardioverter-Defibrillators. Results of a Large, Prospective, Randomized, Double-Blinded, Placebo-Controlled Trial" Circulation: Arrhythmia and Electrophysiology (2009) 2, 29-34.