Surgical site infection

Juan David Vega Padilla[*1,2], José Daniel Sierra Reyes[2], Diego Rodríguez Pineda[2], Edwin Alejandro Barón Muñoz[2], Fabián Andrés Orozco Rodríguez[2], Rosana María Babilonia Yepes[2], Dennis Ximena Murcia Acero[3], Edgar Yovany Cerinza García[4], Ligia Fernanda Sossa Bonilla[5], Daniel Eduardo Gutiérrez Muñoz[6], Jouline Stephanie Joya Pineda[7]

Padilla JDV, Reyes JDS, Pineda DR, Muñoz EAB, Rodríguez FAO, Yepes RMB, Acero DXM, García EYC, Bonilla LFS, Muñoz DEG, Pineda JSJ, Yepes RMB. Surgical Site Infection. Gen Surg: Open Access 2019;2(1):1-3

Objective: To perform a narrative review about operative site infection and its prevention.
Methodology: Non-systematic review of the literature.
Results: Surgical site infection is the second most common type of health care–associated infection and increases hospital morbidity and mortality. It is defined as the infection that affects the surgical incision area or its deep tissue in the first 30 days after surgery and when a prosthesis or implant is used, this time extends up to one year. The most common pathogen in surgical site infections is *Staphylococcus aureus*. Its prevention depends on hospital and pre-hospital interventions (MRSA screening, smoking cessation, bowel preparations, glucose control, skin preparation, antibiotic prophylaxis, among others).
Conclusion: The prevention of surgical site infection is an important objective in health care.
Key Words: *Surgical site infection*; *Surgical wounds*; *Epidemiology*; *Diagnosis*; *Prevention*

INTRODUCTION

Surgical site infection is one of the most studied complications in the world. There are many studies that describe its frequency and also prevent its appearance, however; it continues to be a frequent cause of morbidity and mortality [1]. In 2006, approximately 80 million surgical procedures were performed in the United States [2]. Surgical site infection (SSI) is the second most common type of health care–associated infection [3] and increases hospital morbidity and mortality, causing about 8,000 deaths per year in the United States [4] and in the developing countries may have higher mortality rates [5]. SSI is defined as the infection that affects the surgical incision area or its deep tissue in the first 30 days after surgery and when a prosthesis or implant is used, this time extends up to one year [6].

EPIDEMIOLOGY

The epidemiology of the SSI is heterogeneous because it varies according to the hospital, the surgeon, the type of surgery and the patient [7]. SSI is one of the most common nosocomial infections and causes increase in morbidity, mortality, economic costs, days of hospitalization, use of antibiotics and in the number of surgical procedures [8,9]. SSI complicates 1.9% of surgeries [10] but it may be superior when open surgery is compared to laparoscopic surgery or depending on the type of surgery [6]. The economic costs attributed to the SSI vary from 10,000 to 43,000 dollars per patient and depend on the type of surgery and the causative agent [11,12].

CLASSIFICATION

CDC classification of surgical site infection

The surgical site infection is classified according to the depth in: superficial, deep and organ or space [13]. In the superficial infection only the skin or the subcutaneous cellular tissue is affected and must have at least one of the following criteria: purulent drainage of the incision, organism isolated in culture, pain, edema, erythema or local heat, diagnosis made by surgeon. In deep infection, the fascia or muscle is affected and must have at least one of the following criteria: purulent drainage from the deep incision, dehiscence of the deep wound with positive culture, without culture but with fever greater than 38 degrees or localized pain, evidence of infection involving the deep incision, diagnosis made by surgeon. In the organ or space infection, there is purulent drainage of an organ or space, positive culture, any clinical evidence of organ or space infection or diagnosis made by a surgeon [14].

Classification of operative wounds

Clean: Elective, not emergency, non-traumatic and primarily closed; no acute inflammation; no break in technique; respiratory, gastrointestinal, biliary, and genitourinary tracts not entered.

Clean-contaminated: Urgent or emergency case that is otherwise clean; elective opening of respiratory, gastrointestinal, biliary, or genitourinary tract with minimal spillage not encountering infected urine or bile; minor technique break.

Contaminated: Non-purulent inflammation; gross spillage from gastrointestinal tract; entry into biliary or genitourinary tract in the presence of infected bile or urine; major break in technique; penetrating trauma <4 h old; chronic open wounds to be grafted or covered.

Dirty: Purulent inflammation; preoperative perforation of respiratory, gastrointestinal, biliary, or genitourinary tract; penetrating trauma >4 h old [15].

PATHOGENESIS AND RISK FACTORS

Surgical infections have characteristics that include the primed systemic inflammatory response by surgical insult, immediate postoperative immune suppression, various invasive interventions and anaesthetic. All these previous factors together cause that the course of surgical infections is more complex [16]. SSI arises from an interaction of several factors that include the type and number of contaminating bacteria, the virulence and the resistance of the patient involved. Bacteria involved may originate from the host patient or arise from other sources as the surgical personnel, equipment, and the operating room environment [17,18]. Patient-related risk factors for the development of SSI can be categorized as either unmodifiable or modifiable. The unmodifiable risk factor is the age (increasing age predicted an increased risk of SSI until age 65 years). Modifiable patient-related risk factors include poorly controlled diabetes mellitus, obesity, tobacco use, use of immunosuppressive medications, and length of

[1]*Universidad de Boyacá, Tunja, Colombia;* [2]*Fundación Universitaria, Juan N Corpas, Bogotá, Colombia;* [3]*Fundación Universitaria, San Martin, Bogotá, Colombia;* [4]*Universidad Nacional de Colombia, Bogotá, Colombia;* [5]*Fundación Universitaria de Ciencias de la Salud (FUCS), Bogotá, Colombia;* [6]*Universidad de Ciencias Aplicadas y Ambientales (UDCA), Bogotá, Colombia;* [7]*Fundación Universitaria, Sanitas, Bogotá, Colombia*

*[*]**Correspondence:**Juan David Vega Padilla, Universidad de Boyacá, Tunja, Colombia, Tel: +573123755426; E-mail: ddavids89@hotmail.com*

***Received:** May 03, 2019; **Accepted:** May 16, 2019; **Published:** May 23, 2019*

preoperative hospitalization. Perioperative risk factors include wound class, length of surgery, and shaving of hair, hypoxia and hypothermia [19]. The most common pathogen in surgical site infections is *Staphylococcus aureus* (Table 1).

Table 1
Pathogens in surgical site infections [13]

Pathogens	Percentage of Infections
Staphylococcus aureus	20%
Coagulase-negative *Staphylococci*	14%
Enterococci	12%
Pseudomonas aeruginosa	8%
Escherichia coli	8%
Enterobacter species	7%

PREVENTION

Pre-hospital interventions

MRSA screening: It is recommended screening and nasal mupirocin decolonization for S aureus-colonized patients before total joint replacement and cardiac procedures. Decolonization protocols should be completed close to date of surgery to be effective. Vancomycin should not be administered [20,21].

Smoking cessation: Smoking cessation is recommended for all current smokers, especially those undergoing procedures with implanted materials. Smoking cessation 4 to 6 weeks before surgery reduces SSI [22].

Bowel preparations: Combination mechanical and antibiotic preparation is recommended for all elective colectomies [23].

Glucose control: There is no evidence that improved Hgb A1C decreases SSI risk. However, optimal blood glucose control should be encouraged for all diabetic patients [21,24].

Hospital interventions

Skin preparation: Alcohol-containing preparation should be used unless contraindication exists. If alcohol cannot be included in the preparation, chlorhexidine should be used instead of iodine unless contraindications exist [25].

Surgical hand scrub: Use of a waterless chlorhexidine scrub is as effective as traditional water scrub and requires less time [26].

Antibiotic prophylaxis: Preoperative prophylaxis with appropriately selected procedure-specific antibiotics administered 1 hour before skin incision is a mainstay of SSI prevention [27] (2 h for vancomycin and fluoroquinolones) [28]. Choice of prophylactic antibiotic should be dictated by the procedure and pathogens most likely to cause SSI [29]. There is no evidence that prophylactic antibiotic administration after incision closure decreases SSI risk [30].

Normoglycemia: It is recommend confirming perioperative glucose levels <200 mg/dL in diabetic and non-diabetic patients or an immediate postoperative control in all surgeries 180 mg/dL [13,31]

Oxygenation: It is recommended optimizing tissue oxygenation during surgery, administering a higher inspired oxygen fraction in the operative and immediate postoperative phases and maintaining haemoglobin saturation >95% [31].

CONCLUSION

Its prevention depends on hospital and pre-hospital interventions (MRSA screening, smoking cessation, bowel preparations, glucose control, skin preparation, antibiotic prophylaxis, among others). The prevention of surgical site infection is an important objective in health care.

CONFLICTS OF INTEREST

The authors declare that the research was conducted in the absence of any commercial or financial relationships that be construed as a potential conflict of interest

REFERENCES

1. Fry DE. Fifty ways to cause surgical site infections. Surg Infect. 2011;12:497-500.
2. DeFrances CJ, Podgornik MN. National Hospital Discharge Survey of 2004. Adv Data. 2006;4:1-19.
3. Wenzel RP. Health care-associated infections: Major issues in the early years of the 21st century. Clin Infect Dis. 2007;45:S85-88.
4. Klevens RM, Edwards JR, Richards CL Jr, et al. Estimating health care associated infections and deaths in U.S. hospitals, 2002. Public Health Rep. 2007;122:160-66.
5. Rosenthal VD, Richtmann R, Singh S, et al. Surgical site infections, International Nosocomial Infection Control Consortium (INICC) report, data summary of 30 countries, 2005-2010. Infect Control Hosp Epidemiol. 2013;34: 597-604.
6. Owens CD, Stoessel K. Surgical site infections: Epidemiology, microbiology and prevention. J Hosp Infect. 2008;70:3-10.
7. Nichols RL. Preventing surgical site infections: A surgeon's perspective. Emerg Infect Dis. 2001;7:220-24.
8. Urban JA. Cost analysis of surgical site infections. Surg Infect (Larchmt). 2006;7: 19-22.
9. Broex EC, Van Asselt AD, Bruggeman CA, et al. Surgical site infections: How high are the costs? Journal of Hospital Infection. 2009;72:193-201.
10. Mu Y, Edwards JR, Horan TC, et al. Improving risk-adjusted measures of surgical site infection for the National Healthcare Safely Network. Infect Control Hosp Epidemiol. 2011;32:970-86.
11. Engemann JJ, Carmeli Y, Cosgrove SE, et al. Adverse clinical and economic outcomes attributable to methicillin resistance among patients with Staphylococcus aureus surgical site infection. Clin Infect Dis. 2003;36:592-98.
12. Zimlichman E, Henderson D, Tamir O, et al. Health care-associated infections: a meta-analysis of costs and financial impact on the US Health Care System. JAMA Intern Med. 2013;173:2039-46.
13. Anderson DJ, Kaye KS. Staphylococcal surgical site infections. Infect Dis Clin North Am. 2009;23:53-72.
14. Young PY, Khadaroo RG. Surgical site infections. Surg Clin North Am. 2014;94:1245-64.
15. Smith CD. Zero surgical site infections: Is it possible? Adv Surg. 2012;46:51-60.
16. Cui P, Fang X. Pathogenesis of infection in surgical patients. Curr Opin Crit Care. 2015;21:343-50.
17. Mangram AJ, Horan TC, Pearson ML, 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.
18. Steiner HL, Strand EA. Surgical-site infection in gynecologic surgery: pathophysiology and prevention. Am J Obstet Gynecol. 2017;217:121-28.
19. Garner BH, Anderson DJ. Surgical site infections: An update. Infect Dis Clin North Am. 2016;30:909-29.
20. Schweizer ML, Herwaldt LA. Surgical site infections and their prevention. Curr Opin Infect Dis. 2012;25:378-84.
21. Ban KA, Minei JP, Laronga C, et al. American College of Surgeons and Surgical Infection Society: Surgical site infection guidelines: A 2016 update. J Am Coll Surg. 2017;224:59-74.

22. Moller AM, Villebro N, Pedersen T, et al. Effect of preoperative smoking intervention on postoperative complications: A randomised clinical trial. Lancet. 2002;12:114-17.
23. Fry DE. Antimicrobial bowel preparation for elective colon surgery. Surg Infect (Larchmt). 2016;17:269-274.
24. Acott AA, Theus SA, Kim LT, et al. Long-term glucose control and risk of perioperative complications. Am J Surg. 2009;198:596-99.
25. Sidhwa F, Itani KM. Skin preparation before surgery: Options and evidence. Surg Infect. 2015;16:14-23.
26. Chen CF, Han CL, Kan CP, et al. Effect of surgical site infections with waterless and traditional hand scrubbing protocols on bacterial growth. Am J Infect Cont. 2012;40:15-17.
27. Najjar PA, Smink DS. Prophylactic antibiotics and prevention of surgical site infections. Surg Clin. 2015;95:269-83.
28. Kirby JP, Mazuski JE. Prevention of surgical site infection. Surg Clin North Am. 2009;89:365-89.
29. Ploegmakers IB, Olde Damink SW, Breukink SO, et al. Alternatives to antibiotics for prevention of surgical infection. Br J Surg. 2017;104:24-33.
30. Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm. 2013;70:195-283.
31. Gómez-Romero FJ, Fernandez-Prada M, Navarro-Gracia JF, et al. Prevention of surgical site infection: Analysis and narrative review of clinical practice guidelines. Cir Esp. 2017;95:490-502.