An Evidence-Based Review: Antibiotic Prophylaxis for Surgical Procedures

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Surgical Site Infections (SSIs) are the most common hospital acquired infection in surgical patients. The Centers for Disease Control and Prevention define a surgical site infection as “any infection taking place within 30 days of the procedure or one year if an implant is left in place” (Horton et al., 1992). In an effort to reduce these numbers, perioperative prophylactic antibiotics are routinely administered with each surgical procedure (Salkind & Rao, 2011). The effects of SSIs are dealt with by all units that receive these patients during post-surgical recovery periods.

**Typical Outcome**

Setiawan (2011) stated that the benefits and risks for the use of prophylactic antibiotics should be weighed prior to surgery. When appropriate, Setiawan found that when antibiotics are correctly timed and administered, incidence of surgical site infection was reduced up to four-fold (Setiawan, 2011). The results vary when including other variables including type of antibiotic used, length of operation, amount of contamination, and whether scheduled or emergency surgery was completed.

**Available Research**

The subject of prophylactic antibiotic administration prior to surgery is one that has been very heavily researched over the last few decades. A search of EBSCOhost with the terms “surgical” and “antibiotic prophylaxis” alone yields 180 articles in scholarly journals that have used quantitative methods in random controlled trials do determine the efficacy of administering antibiotics prior to surgery.

**Related Articles**

**Timing of Antibiotic Prophylaxis**
An ongoing Swiss study by Mujagic, Zwimpf, Marti, Zwahlen, Hoffmann, Kindler, and Weber was started last year, in which their findings build on an observational study they conducted in 2008, which showed that patients receiving antibiotics 30-74 minutes prior to the first incision had lower rates of surgical site infections. In this current study, the independent variables will be the time at which the antibiotics will be administered (30-75 minutes prior to surgery, or 30 minutes or less prior to surgery). The dependent variable will be the presence of a surgical site infection within 30 days or one year with an implant device.

The sample size will be 5,000 patients from two tertiary referral centers in Switzerland undergoing a variety of surgeries. Due to the ongoing nature of this study, there are no findings yet. Their a priori hypothesis is based on assessing over 6000 cases from a quality assessment at the University of Basel in 2008 as described above, but they are doing this study to prove that with experimental rather than observational data. The authors of this study claim this is the first Randomized Controlled Trial (RCT) addressing the specific issue of the timing of drug administration.

**Effects of Antibiotic Prophylaxis**

Skjeldestad, Bjørnholt, Gran, & Erisken (2015), completed a quantitative study investigating if having guidelines in hospital policies for use of prophylactic antibiotics in cesarean deliveries would increase compliance of delivering the medications and, thereby, reduce the amount of Surgical Site Infections (SSI) associated with cesarean deliveries. Three groups with varied guidelines were determined. The first had no guidelines and only provided antibiotics when indicated. The second gave antibiotics for all emergency C-sections; while the third group, provided them for all cesarean procedures. Other variables considered in the study were: level of care- University, regional or local; type of cesarean delivery- emergency or
planned; and the type of infection after surgery—superficial or deep—were all considered. The sample size of the study completed consisted of 4,498 women and was later broken down into sections of age, planned/emergency, American Society of Anesthesiologists score, contamination class and duration of surgery for accuracy of results.

The study was quantitative with moderate quality and a grade level of evidence of three. The study was a single research study completed on a large scale with high quality results. The study was observational and did not have a control specific control group selected. The research study data was collected by self-reporting from the hospitals selected and may reflect possible under-reporting. However, the results reported show a significant reduction of superficial SSIs in planned cesarean deliveries in hospitals that were compliant with providing prophylactic antibiotics. The results showed no significant decreased in SSIs in emergency cesarean deliveries or deep SSIs.

The researchers indicated further testing would be needed to help identify other factors that may be affecting the infections in emergency and deep SSIs. Factors mentioned by the researchers to further investigate include: whether emergency setup effects sterility of the area or increases the risk for contamination, whether the duration of the procedure effects the level of contamination due to prolonged surgery and increased damage to surrounding tissues, and whether other antibiotics with increased half-lives should be used to prevent the possibility of reduction of strength mid-procedure.

**Evaluating Use of Routine Antibiotic Prophylaxis**

With healthcare costs and antibiotic-resistant pathogens on the rise, it is important to limit unnecessary use of antibiotics. The research question and overall purpose of this study is, “Do routine prophylactic antibiotics affect the rate of infection in low risk open reduction and internal
fixation surgeries?” Xu, Mao, Liu, Zhu, & Pan (2015) hypothesized that routine perioperative antibiotic treatment does not influence the rate of surgical site infection in clean open reduction and internal fixation patients with a low risk score (Xu, Mao, Liu, Zhu, & Pan, 2015).

The independent variable in this study was the lack of routine antibiotic treatment, Cefuroxime. Cefuroxime was administered 30 minutes before skin incision, 12 hours postoperatively, and 24 hours postoperatively in the control group, whereas none was given to the evaluation group. The dependent variable was the rate of surgical site infection. Patients were evaluated during a follow-up period of 13-17 months post-procedure. All cases of SSI were diagnosed clinically, followed by a microbiological assessment. For the evaluation group (no antibiotics) the sample size was 551. The sample size for the control group (with antibiotics) was 529. The study followed a randomized controlled study format (Xu et al., 2015).

The findings of the study reflected that there is no significant indication for the use of prophylactic antibiotics in low-risk open reduction and internal fixation surgical patients. Future studies should focus on additional risk factors and finding new guidelines for the routine use of prophylactic antibiotics for surgical patients (Xu et al., 2015).

**Article Synthesis**

These articles gave an accurate depiction of how antibiotic prophylaxis affects the occurrence of surgical site infections. Mujagic et al., (2014) came to a result that pre-operative antibiotics are most affective 30-74 minutes prior to a procedure, which is currently inconclusive. The third article determined that antibiotic prophylaxis was ineffective for low risks patients and suggests evaluating patients for risk factors. Despite risk factors and emergency situations antibiotic prophylaxis in perioperative care deems to be beneficial to the prevention of surgical site infections.
Summary and Interventions

Two articles that matched search results for antibiotic prophylaxis in regards to surgery through the Cochrane Database of Systematic Reviews will be evaluated. The first article dealt with infection prevention with long bone fractures because “surgical site infection and other hospital-acquired infections cause significant morbidity after internal fixation of fractures” (Gillespie & Walenkamp, 2010). The primary factor in this review was a systemic antibiotic given during surgery, and concluded that single doses greatly reduced the rate of infection.

The second article was concerned with colorectal surgery infection prevention because “research shows that administration of prophylactic antibiotics before colorectal surgery prevents postoperative surgical wound infection” (Nelson, Gladman, & Barbateskovic, 2014). In this review, the preoperational antibiotic, given orally or intravenously, were proven to be very successful in the reduction of infections, for both aerobic and anaerobic bacteria. Further testing is needed to determine the most desirable dosage, timing, duration of dosing, and frequency of long-term effects.

To summarize the recommended interventions from these meta-analyses of the effectiveness of surgical antibiotic prophylaxis, the administration of antibiotics prior to surgery reduces the occurrence of surgical site infections and may prevent other infections as well.

According to the Joanna Briggs Institute ranking of levels of evidence, “at level 1, two types of evidence rank highest: (1) a meta-analysis of randomized controlled trials (RCTs) with homogeneity of experimental studies, or (2) one or more large experimental studies with narrow confidence intervals” (Hopp & Rittenmeyer, 2012, p. 146). These two articles meet the criteria for the highest level of evidence. The level of evidence of all of these interventions is a level one.

Evidence for Change
We chose to compare the evidence recommended in our research articles to the surgical policies and procedures used by the American Society of Health-System Pharmacists (ASHP). These are “guidelines intended to provide practitioners with a standardized approach to the rational, safe and effective use of antimicrobial agents for the prevention of surgical site infections” (Am J Health-Syst Pharm, 1999).

The first article suggests that giving a single dose of antibiotics greatly reduces infection rates in long bone fracture surgeries, specifically the internal fixation of fractures. According to ASHP, their policy suggests administering a prophylactic antibiotic pre-op then every eight hours for twenty four hours postoperatively. This dosing is above and beyond what our article suggests but still goes along with the idea that antibiotic prophylaxis is important in fighting post-operative infections.

The second article we reviewed recommended that antibiotics given prior to colorectal surgeries reduce the rate of SSI. The ASHP guidelines suggest starting antibiotics up to nineteen hours preoperatively to decrease the chances of infection. This policy agrees with the research we found in our article. After comparing our research with the ASHP recommendations there is not sufficient evidence to warrant a change in policy and procedures.

**Conclusion**

The use of antibiotic prophylaxis has become a widely used protocol in most surgical settings. There is still research to be done to evaluate the effectiveness of the treatment through various surgical procedures. Each surgical procedure provides different results for the effectiveness of the antibiotics. This information draws the interest for more specific research on antibiotic prophylaxis.
References


Setiawan, B. (2011). The role of prophylactic antibiotics in preventing perioperative infection.


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“I pledge to support the Honor System of Old Dominion University. I will refrain from any form of academic dishonesty or deception, such as cheating or plagiarism. I am aware that as a member of the academic community it is responsibility to turn in all suspected violators of the Honor Code. I will report to a hearing if summoned.”

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