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Original research

A review of prophylactic antibiotics use in plastic surgery in China and a systematic review

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HIGHLIGHTS

- Among 13,997 cases with Class I surgical incisions in 2009–2010, 13,865 cases (99.1%) were given prophylactic antibiotics.
- Antibiotics were administered postoperatively in >99% of cases while preoperative administration in 32 cases (0.23%).
- Wound infections occurred in 21 cases for an overall infection rate of 0.15%.
- Systematic review revealed marked variation in the timing and wound infections for the use of antibiotic administration.
- Prophylactic antibiotics are overused in plastic surgical procedures, and there is broad variation in drug administration.

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ABSTRACT

The purpose of this study was to investigate the use of antibiotic prophylaxis for plastic surgical procedures at our hospital, and to perform a systematic literature review of randomized controlled trials evaluating the use of prophylactic antibiotics in plastic surgery. The records of patients who received plastic surgical procedures with Class I surgical incisions between 2009 and 2010 were retrospectively reviewed. A systematic literature review was conducted for studies examining the use of prophylactic antibiotics for Class I surgical wounds. A total of 13,997 cases with Class I surgical incisions were included. Prophylactic antibiotics were given in 13,865 cases (99.1%). The antibiotics used were primarily cefuroxime, clindamycin, metronidazole, cefoxitin sodium, and gentamicin. The average duration of administration was 4.84 ± 3.07 (range, 1–51) days. Antibiotics were administered postoperatively in >99% of cases while preoperative antibiotic administration was only given in 32 cases (0.23%). Wound infections occurred in 21 cases for an overall infection rate of 0.15%. Fourteen studies met the inclusion criteria of the systematic review. There was marked variation in the timing of antibiotic administration with antibiotics given pre-, peri-, and postoperatively. Of studies that compared the use of prophylactic antibiotics with placebo, a reduction in wound infections was noted in 4 trials and no difference was noted in 6 trials. No significant difference in infection rates was shown between the prophylactic and postoperative arms. In conclusion, prophylactic antibiotics are overused in plastic surgical procedures. Evidence-based guidelines for the use of prophylactic antibiotics in plastic surgical procedures are needed.

1. Introduction

Surgical site infections are defined as infections that occur near or at a surgical incision within 30 days of the surgery, and are a major cause of morbidity in patients that have undergone surgery [1]. Surgical antibiotic prophylaxis refers to the short-term

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administration of antibiotics before the beginning of surgery, and has clearly been shown to reduce the incidence of surgical site infections [2]. Prophylaxis with antibiotics has been shown to be effective in many procedures including gastrointestinal, oropharyngeal, vascular, open heart, obstetric and gynecological, and orthopedic, and clear recommendations for their use have been developed [1,2]. Because their use is preventative they are used in operations in which minimal microbial contamination of the surgical site is expected, e.g., clean Class I surgical wounds [1,2]. General principles of antibiotic prophylaxis indicate that the first dose should be given before the incision, the antibiotic should be effective for the causative organism of the potential infection, a full therapeutic dose should be administered, and antibiotics should be continued no longer than 24 h after the procedure is completed [1,3].

While clear guidelines have been established for antibiotic prophylaxis in many surgical procedures, guidelines for their use in plastic surgical procedures are lacking, and some experts consider their use unwarranted in "clean" procedures because the rate of infections is so low [1,2]. However, the use of prophylactic antibiotics in clean surgery is widespread and their timing of administration and selection is often based on convention and personal and local departmental preferences. There is also a tendency towards excessive administration of antibiotics, and lack of sufficient robust evidence on which to base such decisions for antibiotic prophylaxis in plastic surgery.

In 2004 Ministry of Health in China published the "Principles and guidelines for clinical applications of prophylactic antibiotics" [4]. In the wake of the long history of prophylactic antibiotics abuse in China, the Ministry of Health published official guidelines for the clinical use of prophylactic antibiotics in February 2012, titled: "Principles of managing the clinical application of prophylactic antibiotics" [5]. The guidelines were implemented in August 2012. According to the regulations, prophylactic antibiotics are classified into 3 categories: use without restriction, use with restriction, and antibiotics used in special circumstances. When combined, there should be no more than 2 antibiotics (intravenously or orally, respectively) prescribed within the same group of prophylactic antibiotics. Hospitals and medical centers are required to record the supply and usage of prophylactic antibiotics. Physicians are required to refer to official guidelines for the application of prophylactic antibiotics.

The guidelines state that for clean surgeries, antibiotics should be given within ½ to 2 h prior to the procedure or with anesthesia pre-medications, and that the effect of prophylactic antibiotics should cover the duration of surgery and 4 h after the surgery, and should not be administered for more than 24 h in total. Evaluation of the rationality of prophylactic antibiotic therapy was carried out according to the guidelines at our hospital, a center that specializes in plastic surgery, which are based on the guidelines above. It was concluded that irrational application of prophylactic antibiotics includes: 1) A rate of prophylactic antibiotic application >30%; 2) Administration of antibiotics for a duration of $\leq$24 h <90%; 3) Antibiotics administered 1 day prior to surgery or only postoperatively; and 4) The use of antibiotics without a clear indication.

The purposes of this study were to 1) review the use of prophylactic antibiotic at tertiary care medical center that performs only plastic surgical procedures in the period preceding the publication of the guidelines by the Ministry of Health, and 2) to perform a systematic literature review of randomized controlled trials (RCTs) examining the use of prophylactic antibiotics to prevent surgical site infections (SSIs) in plastic surgical procedures.

2. Materials and methods

2.1. Clinical study

In this study, the medical records of patients who had plastic surgery with Class I wounds from January 1, 2009 to December 31, 2010 at a tertiary care national medical center in which only plastic surgical procedures are performed were retrospectively reviewed. This study was approved by the Institutional Board of the Plastic Surgery Hospital affiliated to the Chinese Academy of Medical Sciences and Peking Union Medical College, and because of the retrospective nature the requirement of patient informed consent was waived.

Data extracted from the medical records included the patients' name, gender, age, length of stay, primary diagnosis, primary surgical procedure, surgeon, major surgical incision type, type of healing, the occurrence of incisional infection, whether prophylactic antibiotics were used, type of used antibiotics, duration of antibiotic administration, method of antibiotic administration, dosage, and timing of prophylactic antibody therapy.

A Class I/clean surgical wound was defined according to the Healthcare Infection Control Practices Advisory Committee (HICPAC) Guideline for Prevention of Surgical Site Infection, 1999 [1]. Briefly, a Class I wound was an uninfected operative wound in which no inflammation was present and the respiratory, alimentary, genital, or uninfected urinary tract was not entered. The wound was closed primarily, and drained, if necessary, with closed drainage. Operative incisional wounds following nonpenetrating (blunt) trauma were included if the other criteria were met. Wound healing was classified as primary, secondary, or tertiary intention [6]. Primary healing was defined as the wound edges approximated and closed with sutures, staples, or adhesive tape. Secondary healing was defined as wound healing by granulation. Healing by tertiary intention was defined as initial debridement, observation for 4–5 days, and then closure.

2.2. Systematic literature review

A systematic literature review was conducted for studies examining the use of prophylactic antibiotics for Class I surgical wounds. A search was conducted of Medline, Cochrane, EMBASE, and Google Scholar on July 31, 2013 using combinations of the following keywords: prophylactic antibiotics/agents, antimicrobial prophylaxis, antibiotic prophylaxis, antibiotics, plastic surgery, and reconstructive surgery. Inclusion criteria were 1) randomized controlled trial; 2) examined the use of prophylactic antibiotics pre-, peri-, or post-operatively in surgical cases with Class I wounds; 3) English language.

Studies were identified by the search strategy by one reviewer. A second reviewer extracted the following information/data from studies that met the inclusion criteria: the name of the first author, year of publication, study design, number of participants in each treatment group, participants' age, the type, dosage, timing, and route of administration of the antibiotics, and the results. The primary outcome of interest was the surgical site infection rate.

2.3. Statistical analysis

Data of prophylactic antibiotic use, surgical infections, and wound healing by primary, secondary, and tertiary intentions were summarized as number (percentage). Data were recorded and analysis performed using Microsoft Office Excel 2007.