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Original Article

Efficacy of 24 hours versus 5 days of prophylactic antibiotics for the prevention of surgical site infection in outpatient elective facial plastic surgery

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ABSTRACT

Background: The discovery of penicillin marked a paradigm shift in medicine with the ability to treat previously life-threatening infections. Increasing antibiotic resistance as well as the risk of adverse reactions to antibiotics, however, creates pressures for judicious use. There continues to be debate about the role of prophylactic antibiotics in facial plastic surgery. This study explores the role of prophylactic antibiotic administration in elective outpatient facial plastic surgery by comparing 5 days versus 24 hours of antibiotic prophylaxis.

Method: A retrospective cohort study of all consecutive patients undergoing cosmetic procedures at an outpatient facial plastic surgical center who received either 5 days or 24 hours of prophylactic antibiotics was performed. The primary outcome was the need for postoperative antibiotics within 6 weeks of surgery.

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Results: 204 patients met the inclusion criteria: 104 in the 5-day group and 100 in the 24-hour prophylaxis group. The overall infection rate was 3.4%: 3% in the 24-hour group and 3.8% in the 5-day group ($p = 0.77$). Subgroup analysis of clean-contaminated cases ($n = 85$) showed the rate of postoperative infections was 4.3%, all within the 5-day group. In clean cases ($n = 119$), the rate of postoperative infections was 4.2% ($n = 5$): 4.8% ($n = 3$) in the 24-hour group versus 3.5% ($n = 2$) in the 5-day group.
Conclusions: The results show that decreasing the duration of antibiotics was not associated with an increased risk of postoperative infection. Given that antibiotics are an increasingly precious commodity with rising rates of resistance, this study supports the use of decreasing postoperative antibiotics to 24 hours.

Introduction

Surgical site infections (SSIs) are the second most common cause of nosocomial infections and account for 14%–16% of all hospital acquired infections.[1,2] An SSI is defined as an infection occurring up to 30 days after surgery if no implant had been placed, or up to 1 year after implantation surgery, which affects either the incision or deep tissue at the operative site.[3,4] The incidence of these infections varies widely by surgical site, type of procedure, and comorbid conditions.[5] In head and neck surgery, the frequency of SSI is <1% for clean procedures.[6,7] For patients undergoing plastic surgery, especially involving the face, the rate of infection is <5%.[2,8,9] However rare, an SSI can result in devastating consequences for patients with increased morbidity and a poor cosmetic outcome.[9]

Prophylactic antibiotic treatment is used to prevent SSIs and their complications.[3,4] Common clinical practice involves using prophylactic antibiotics for the prevention of SSI for a range of surgical procedures. However, current clinical practice guidelines in the field of plastic surgery lack specificity in their recommendations. For example, the section on plastic surgery in the surgery clinical practice guidelines published in Surgical Infections in 2013 recommends antimicrobial prophylaxis to prevent SSI, limit adverse events, and reduce antimicrobial resistance but is unclear on the specific recommended duration.[8] Moreover, knowledge and implementation of the existing guidelines remain scattered.[10]

To provide this necessary guidance for the role and appropriate utilization of antibiotics in the prevention of infection, a number of studies, systematic reviews, and meta-analysis have been undertaken.[11-13] However, these studies all examined the utility of prophylactic antibiotics, rather than the duration or safety of implementation of a change in practice. Comparisons of the duration of prophylactic antibiotic use are limited although they have trended toward showing no difference between shorter versus longer duration.[14,15] Extrapolation from the head and neck oncology and free flap literature currently advocates for discontinuation of prophylactic antibiotics within 24 hours.[7,16-18] In summary, significant uncertainty exists regarding the duration of prophylactic antibiotics and their use in elective facial aesthetic surgery.

The objective of this study is to assess the use of 24 hours of prophylactic antibiotics versus 5 days of prophylactic antibiotics in the prevention of SSIs in a private practice, outpatient, cosmetic surgery setting.

Materials and Methods

Study design and setting

We performed a retrospective cohort study of patients who underwent surgery at an outpatient ambulatory surgical center in Tampa Florida between September 2017 and May 2019 as part of a quality improvement effort. 104 patients receiving 5 days of antibiotics were collected from September 2017 to March 2018 at which time a change in practice was instituted whereupon patients then received 24 hours of antibiotics, allowing collection of 100 patients with this regimen from September 2018 to May 2019 (100 patients).

Participants (inclusion exclusion criteria)

All consecutive adult patients undergoing any cosmetic procedures at the outpatient facial plastic surgical center were eligible for inclusion. Patients undergoing full face fractionated CO_2 laser resurfacing, those who had packing placed in the nose, or those who underwent rhinoplasty with rib graft placement were excluded from the review. It was thought that the removal of the epithelial protective layer of skin with lasering or placement of a foreign body with rib graft /packing would create a different category for injection risk, although this has been underexplored.

Outcomes

The primary outcome was the postoperative infection rate defined as an infection at the surgical site within 6 weeks of surgery, which required the prescription of antibiotics. The decision for antibiotic prescription was made by the senior author. The rate of infection in clean versus clean-contaminated procedures, the effect of procedure type, duration of surgery, and the total number of procedures were additionally examined.

Procedures/Data sources

All included subjects receiving the 5-day antibiotic administration policy period received a 5-day course of antibiotics starting at the time of surgery. All patients received 1 g of cefazolin at the time of surgery and were prescribed 500 mg of cephalexin twice daily for 5 days after the procedure. Patients in the 24-hour antibiotic group received a single dose of 1 g of cefazolin at the time of surgery and then a dose of 500 mg of cephalexin in the evening after surgery. For patients with a penicillin allergy, 600 mg of IV clindamycin was administered at time of surgery followed by either 300 mg of clindamycin twice daily for 5 days or 300 mg of clindamycin in the evening of surgery for the two study groups, respectively.

Additional data collected included age, gender, type of procedure performed, wound classification, duration of surgery, and number of total procedures performed during the single anesthetic event.

Statistical analysis

Statistical analysis was undertaken using GraphPad Prism (version 8;00 for Mac). Standard descriptive statistics were used to analyze the collected data. Categorical data were analyzed using Fisher's exact test with confidence intervals estimated by the Baptista–Pike method. An unpaired *t*-test was used for comparison of parametric data. A p value of <0.05 was considered significant for all data endpoints.

Results

Patient and procedure characteristics

A total of 204 patients met the inclusion criteria, of which 104 patients received the 5-day prophylactic antibiotic regimen and 100 received the 24-hour prophylactic antibiotic regimen. These groups

Table 1
Demographics and procedure statistics.

Number of patients	24-hour prophylaxis 100	5-day prophylaxis 104
Sex		
female	86 (86.0%)	88 (84.6%)
male	14 (14.0%)	16 (15.4%)
Mean age (years)	45.9 +/− 17.4	46.0 +/− 17.1
General anesthesia	62 (62%)	70 (67%)
Average procedure time (minutes)	157 +/− 77.4	172 +/− 84.4
Clean versus clean contaminated	72 (72%)	57 (55%)

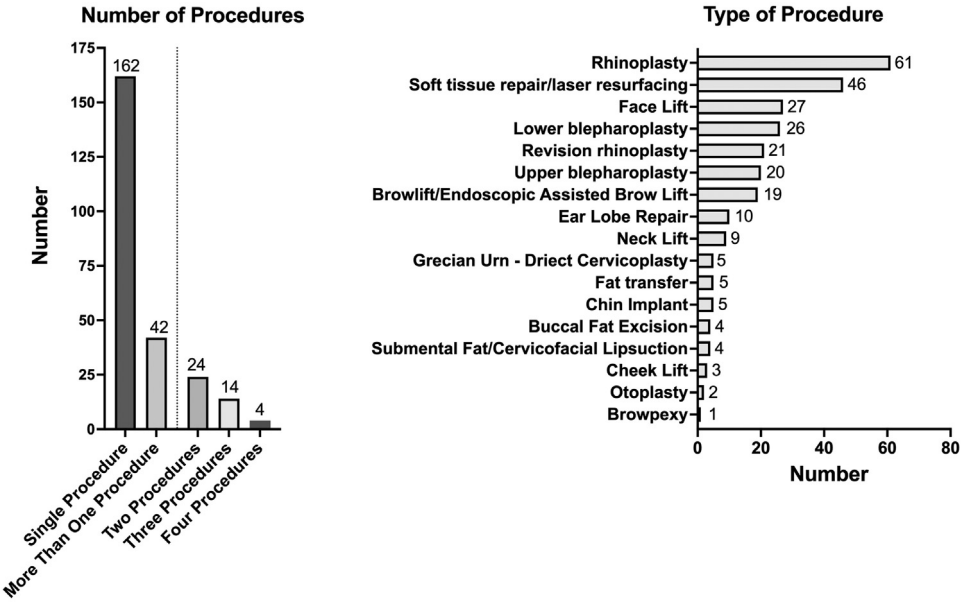

Figure 1. (A) The number of procedures a patient underwent during the surgery are listed, including whether the patient underwent a single procedure, multiple procedures, and the number of multiple procedures. (B) The number of each type of procedure is shown.

had a similar composition in terms of gender (86% female in the 24-hour group versus 85% in the 5-day group) and age (46 years; ±17 for both groups). A statistically significant difference was noted for procedure type with 72% clean procedures (as opposed to clean-contaminated) in the 24-hour group versus 55% in the 5-day group ($p = 0.0135$) (Table 1).

The majority of patients underwent a single procedure ($n = 162$, 79%). Of the 21% of patients having combined procedures, 24 had two procedures (12%), and a decreasing number of patients had a greater number of procedures. Rhinoplasty, soft tissue repair, and face lift were the three most common procedures in both groups (50%) (Figure 1).

General anesthesia was administered in 132 out of 204 cases (65%), and the average length of anesthesia for all cases was 165 minutes. The average length of anesthesia was 157 +/− 77.4 minutes in the 24-hour group versus 172 +/− 84.4 minutes in the 5-day group, which was not a statistically significant difference ($p = 0.3005$) (Table 1).

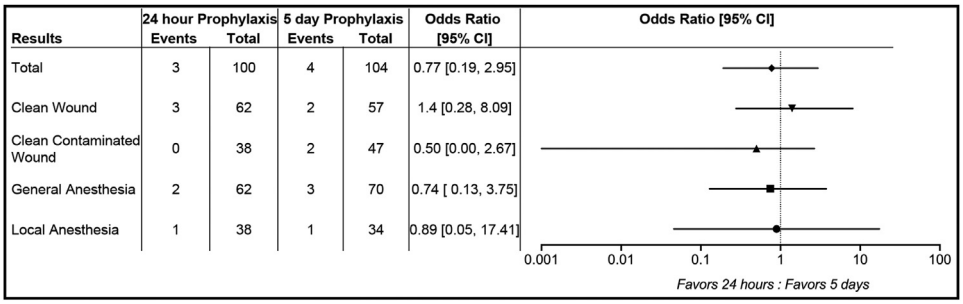

Figure 2. Overall postoperative infection rate with key subgroup analysis for clean and clean-contaminated wound classifications as well as general and local anesthesia with the odds ratio and 95% confidence interval associated with changing to a 24-hour postoperative antibiotic course.

Outcomes

The overall rate of postoperative infections requiring prescription of antibiotics was 3.4% ($n = 7$). The presentation of the infection was mostly soft tissue edema, erythema, and increasing pain at the surgical site. There were no instances of flap failure identified. The rate of postoperative infections requiring prescription of antibiotics in the 24-hour group was 3% ($n = 3$) versus 3.8% ($n = 4$) in the 5-day group ($p = 0.78$), yielding an odds ratio of 0.77 (CI 0.19 to 2.95) (Figure 2).

Subgroup analysis: clean-contaminated versus clean wound class patients

Overall, 85 patients were in the *clean-contaminated wound class* group, of which 38 were in the 24-hour group and 47 were in the 5-day group. The overall rate of postoperative infections requiring prescription of antibiotics in the clean-contaminated class was 4.3% ($n = 2$). As illustrated in Figure 2, all the cases of postoperative infections requiring prescription were in the 5-day group only. The rate of postoperative infections requiring prescription in the 24-hour group was 0% ($n = 0$, OR 0.50, 0.00–2.67) (Figure 2).

Overall, 119 patients were in the *clean wound class* group, of which 62 were in the 24-hour group and 57 were in the 5-day group (Figure 2). The overall rate of postoperative infections requiring prescription of antibiotics in the clean wound class group was 4.2% ($n = 5$). The rate of postoperative infections requiring prescription of antibiotics in the 24-hour group was 4.8% ($n = 3$) versus 3.5% ($n = 2$) in the 5-day group (OR = 1.40; 95% CI 0.28 to 8.09).

Effect of general vs local anesthesia

To further explore an additional factor that might affect the rate of postoperative infections, the effect of use of general anesthesia versus local anesthesia was assessed as a marker of procedure complexity and increased risk. For patients undergoing general anesthesia, 3.2% ($n = 2$ out of 62) had a postoperative infection requiring antibiotics in the 24-hour group, compared with 4.2% ($n = 3$ out of 70) in the 5-day group (OR 0.74, CI 0.13 to 3.75) (Figure 2). By comparison, in the local anesthesia group, 2.6% ($n = 1$ out of 38) of the 24-hour group and 2.9% ($n = 1$ out of 34) in the 5-day group had postoperative infections (OR 0.89, 0.05 to 17.41).

Discussion

The findings of this study show that the overall infection rate in facial plastic surgery conducted in an outpatient setting is low (3.4%), and decreasing the duration of postoperative prophylactic antibiotics from 5 days to 24 hours was associated with a 23% reduction in the odds of infection, although this was not a statistically significant finding. Neither anesthesia time nor clean versus clean-contaminated wound classification had a significant effect on the risk of postoperative infection. Given

the significant increase in morbidity and healthcare cost with any infectious complications in an elective, cosmetic setting, it is important to carefully consider the ramifications of any change in practice. This must be balanced against the critical need to reduce the development of antibiotic resistance, which is largely driven by unnecessary prescribing practices. Notably, these findings indicate that a reduction in duration of antibiotics is not associated with an increased risk of infection.

The overall rate of postoperative infections we encountered is in line with other studies. In a plastic surgery setting, the rate of SSI ranges between 0.003% and 3.8%.[2,7] This variation in rates of SSI is most likely due to various factors including the method of recording incidence of SSI (self- reporting versus mandatory tracking), institutional chart review or database use, etc. For example, the rate of SSI in breast surgery and abdominoplasty was 3.5% when using the mandatory tracking method and only 0.7% when using an insurance claims database that tracks only severe infections.[19,20] In our study, the rate of SSI was 3.4% based on the need for antibiotics, which is in line with studies employing similar definitions and patient populations. A prospective multicenter study by Drapeau *et al.* assessed the incidence of SSI in plastic and reconstructive surgery in 23 Italian plastic and reconstructive units and reported an overall rate of 3%.[21]

The role of surgical prophylaxis has been explored previously in plastic surgery. A 2015 systematic review and meta-analysis by Ariyan et al. looking at the role of prophylactic antibiotics in the prevention of SSI in a plastic surgery case found that the utilization of prophylactic antibiotics led to a reduction in SSI, but it was not statistically significant.[11] A randomized control trial of 1400 patients by Baran, which contained 170 patients undergoing facial cosmetic procedures, concluded that there was no significant difference in key outcomes with administration of prophylactic antibiotics.[12] In contrast, a meta-analysis of 2395 patients performed by Zhang et al. showed that prophylactic antibiotics reduced SSIs.[13]

Although no other study has specifically examined a 24-hour regimen compared to a 5-day regimen of prophylactic antibiotics in elective facial plastic surgeries, our study results are in line with the results of a systematic review and meta-analysis by Oppelaar *et al.* investigating the risk of SSI with $\leq$24 hours of antibiotics versus $\geq$72 hours of postoperative antibiotics in otolaryngologic and maxillofacial surgery. They reviewed 21 articles (a total of 1974 patients) and found that there was no significant difference in occurrence of postoperative infections between patients receiving less than 24 hours of antibiotics compared to 72 hours or longer.[14] An additional systematic review and meta-analysis by Vander Poorten *et al.* investigating perioperative antibiotics in clean-contaminated head and neck surgery pooled 15 studies where short- vs long-term antibiotic prophylaxis was compared and concluded that treatment for more than 48 hours did not further reduce wound infections.[15]

A study by Villanueva *et al.* assessed the efficacy of short- versus long-term antibiotic regimens for preventing SSIs in patients undergoing clean-contaminated maxillofacial surgery. While the question appears to be similar, short or long term in this study referred to the dose and not the duration, and therefore, the goals are not compatible with our study. Furthermore, the study did not provide any details on either the dose or schedule of antibiotic administration beyond calling the groups long or short term.[22] Nevertheless, the finding of a similar rate of SSIs with long- or short-term antibiotic usage is in line with our results.

Most studies in a plastic surgery setting assessing the role of antibiotics for preventing SSI compared antibiotics to no antibiotics or a placebo. A recent study among breast reconstruction patients conducted a randomized controlled trial comparing single to multiple dose surgical prophylaxis. The study concluded that multidose intravenous antibiotics were not superior to the single-dose regimen and were not recommended to avoid higher rates of adverse events.[23] The largest systematic review and meta-analysis on the role of prophylactic antibiotics versus no antibiotics/placebo for the prevention of SSI in plastic surgery involving 66 studies recommended the use of prophylactic antibiotics. However, none of the included studies assessed the optimal schedule of antibiotics and noted only that the antibiotic regimen for the included studies ranges from a single dose perioperatively to a 5-day regimen.[11] Indeed, there is a wide range of practices reported in the facial plastic literature with regard to postoperative antibiotic use.[24–29]

A recent systematic review and meta-analysis conducted by Nuyen *et al.* sought to examine the role of prophylactic antibiotics in septorhinoplasty. While their initial survey of the literature identified 262 reports, only 5 were randomized controlled trials that met their inclusion criteria, speaking

to the dearth of well-conducted and recent studies on the subject. However, their study did pool 589 participants and compared a range of antibiotic regimens to either a single dose within 24 hours of incision or no antibiotic. They found no significant difference in the outcomes of prophylactic antibiotics given preoperatively or postoperatively compared with perioperative or placebo.[30] While our study is retrospective in nature, it does provide data on the critical intermediate step of decreasing the duration of postoperative antibiotics as compared to eliminating them.

The role of prophylactic antibiotics in the setting of plastic surgery continues to be a source of debate, and the use of the precious commodity of antibiotics continues to be increasingly scrutinized. Constant re-examination of practice habits should therefore be a priority for the field. According to a survey among the members of the American Rhinologic Society, the most common reasons for antibiotic prophylaxis are the prevention of postoperative infections (60.4%), avoidance of toxic shock syndrome (31.5%), and self-protection against legal–medical proceedings (4.9%).[29] In addition to the lack of clear evidence for the use of antibiotics in facial plastic surgery, there is also the question of the presence of lack of guidelines as well as whether the individual surgeon follows these guidelines. In a survey by Hauck, only 36% of surgeons responding always follow their institution's policies, whereas 12–15% do not know whether there is a specific guideline in their institution.[10] The continued wide variance in practice, as well as little published data regarding implementation of guidelines into a range of practice settings, continues to hamper systemic changes in antibiotic utilization. The results from our study fill an important clinical gap by directly evaluating the safety of a change in practice in an elective outpatient cosmetic setting and show that "less is more".[31]

Limitations

There are limitations associated with the study. This study is observational and retrospective, so unknown factors may influence the overall results. However, we included all consecutive subjects with clear *a priori* defined inclusion criteria, thereby reducing the impact of selection bias. Our patients were all healthy enough to undergo elective aesthetic surgery, and none had significant immunocompromise from disease or medication or active dermatologic issues that might have predisposed them to infection. That being said, the full medical records for these patients were not accessible to the authors to allow for a complete evaluation of unexpected confounding factors. In general, the groups were well balanced for known factors suspected to be associated with infection rates. We note that the 5-day antibiotic group comprised more cases of clean-contaminated surgery than the 24-hour group; however, when clean and clean-contaminated cases were examined individually, there was not a statistically significant difference in the outcomes based on the duration of antibiotics.

We considered the risk based on total anesthesia time, but it is notable that some cases were performed with only a local anesthetic, so the duration of anesthesia time was not applicable. We deferred the evaluation of local versus general anesthesia as a risk factor for infection as the complexity of the case and the likely risk of infection were not well stratified by this distinction.

Furthermore, we assessed the impact of these factors using multivariate analysis and found that their effect was not statistically significant in this data set; however, our findings were limited by the sample size, and it is possible that important subgroups and confounding variables could be identified in follow-up studies. Nevertheless, this is the first study to our knowledge to undertake a head-to-head comparison of short- versus long-term usage of prophylactic antibiotics for the prevention of SSI in a range of completely elective facial plastic procedures performed at an ambulatory surgery center and thus has broad applicability to many private practice models.

While the findings from this study have several limitations, these data suggest the need for additional well-designed and powered randomized controlled trials to further inform recommendations in evidence-based clinical practice guidelines.

Conclusions

Antibiotics are a powerful tool in healthcare, but amid the rising tide of antibiotic resistance, there is an urgent need to carefully examine the use of this precious commodity. In addition, antibiotics are not without their own risks and side-effects. The results of this study indicate that utilization of only

24 hours of prophylactic antibiotics for preventing SSI in an outpatient elective facial plastic surgery practice is a practice shift that can be safely accomplished.

Ethical Approval

Ethics approval was obtained from the University of South Florida's Institutional Research Board under study number 000318.

Declaration of competing interest

The authors of this publication have no competing interests or financial disclosures.

Author Contribution Statement

J.T., M.W.R., and E.H.F. were responsible for conceiving and planning the experiments and collecting the data. J.T., J.Z.P., and A.K. performed statistical analysis. All authors contributed to the interpretation, writing, and editing of the manuscript.

All co-authors have reviewed and approved the manuscript prior to its submission.

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