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Effectiveness of Prophylactic Antibiotics in Outpatient Plastic Surgery

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Abstract

Background: The effectiveness of prophylactic antibiotics has not been established for patients who undergo plastic surgery as outpatients, and consensus guidelines for antibiotic administration in clean-contaminated plastic surgery are not available.

Objectives: In a retrospective study of outpatients, the authors examined preoperative timing of prophylactic antibiotics, whether postoperative antibiotics were administered, and whether any correlations existed between these practices and surgical complications.

Methods: The medical records of 468 plastic surgery outpatients were reviewed. Collected data included preoperative antibiotic timing, postoperative antibiotic use, comorbidities, and complications. Rates of complications were calculated and compared with other data.

Results: All 468 patients received antibiotics preoperatively, but only 93 (19.9%) received them ≥1 hour before the initial incision. Antibiotics were administered 15 to 44 minutes before surgery in 217 patients (46.4%). There was no significant difference in complication rates between the 315 patients who received postoperative prophylactic antibiotics (16.2%) and the 153 who did not (20.9%). Comorbidities had no bearing on postoperative complications.

Conclusions: Postoperative antibiotic prophylaxis may be unnecessary for outpatient plastic surgery patients.

Level of Evidence: 3

Keywords

outpatient surgery, antibiotics, prophylaxis, complications, comorbidities

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The effectiveness of prophylactic antibiotics in plastic surgery has not been established.[1,2] Although the prophylactic utility of preoperative and postoperative antibiotics has been evaluated for orthopedic and general surgery[3] and for breast augmentation,[1] data are unavailable regarding antibiotic administration in the general setting of outpatient plastic surgery.[2] The goal of prophylactic antibiotic treatment is to prevent surgical site infections (SSIs), defined as infections occurring up to 30 days after surgery if no implant had been placed, or up to 1 year after implantation surgery, and affecting either the incision or deep tissue at the operation site.[3] Even though prophylactic antibiotic use has increased over the years, postoperative wound infection rates have remained nearly constant for the past 4 decades.[4]

Medicare and Medicaid reforms under the Affordable Care Act include provisions to improve the quality of healthcare. The Physician Quality Reporting System provides financial

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Table 1. Timing of Preoperative Administration of Antibiotics Relative to Initial Incision

	Minutes Before Administration, n (%)								
Patients	>120	120-75	74-60	59-45	44-30	29-15	14-0	>0[a]	NA
Women[b]	21 (4.85)	37 (8.55)	25 (5.77)	22 (5.08)	80 (18.5)	129 (29.8)	43 (9.93)	12 (2.77)	63 (14.5)
Men[c]	2 (5.71)	6 (17.1)	2 (5.71)	1 (2.86)	2 (5.71)	6 (17.4)	6 (17.4)	1 (2.86)	9 (25.7)
Total[d]	23 (4.91)	43 (9.19)	27 (5.77)	23 (4.91)	82 (17.5)	135 (28.8)	49 (10.5)	13 (2.78)	72 (15.4)

Abbreviation: NA, data not available.
[a]The >0 category is defined as patients receiving the first dose of prophylactic antibiotics at the time of incision or perioperatively.
[b]n = 432.
[c]n = 35.
[d]N = 467.

incentives to physicians who report quality data, including information on the administration of prophylactic antibiotics, to the Centers for Medicare and Medicaid Services.[5] The Physician Quality Reporting System will transition from a voluntary to a mandatory program in 2015, and the Centers for Medicare and Medicaid Services will reduce payments for physicians who do not report quality data. The potential benefit of prophylactic antibiotics for plastic surgery patients should be determined before this provision takes effect.

The purpose of preoperative antibiotic treatment is to "reduce intraoperative contamination to levels where it does not overwhelm the patient's defenses."[3] However, the optimal timing for antibiotic prophylaxis is debatable.[6-9] The Centers for Disease Control and Prevention recommends administering antibiotics between 120 minutes (for vancomycin) and 60 minutes (for all others) before incision.[8] According to the Surgical Care Improvement Project (SCIP), patients who received antibiotics within 30 minutes of the incision had the lowest risk of infection.[3] Other investigators have suggested that rates of infection are lower if the antibiotic is administered a short time (ie, less than 30 minutes to immediately) before the initial incision.[6,9] However, the administration of prophylactic antibiotics may not decrease infection rates in clean-contaminated plastic surgery cases,[1,7] and consensus guidelines for antibiotic prophylaxis in plastic surgery are not available.

In this retrospective review of an outpatient plastic surgery population, the authors evaluated the timing of preoperative antibiotic delivery and the occurrence of postoperative antibiotic administration to discern potential correlations with complication rates and to assess whether prophylactic antibiotics are beneficial in this surgical setting.

METHODS

Study Design

This retrospective chart review was approved by the Institutional Review Board at the University of Texas (UT) Southwestern Medical Center, and the study was conducted in accordance with the guidelines of the Declaration of Helsinki. The study population included a subset of 1801 plastic surgery encounters (ie, any instance of a patient undergoing surgery; operations in the same patient on different dates corresponded to different encounters) comprising complex reconstructive and body contouring procedures as defined by Current Procedural Terminology codes. Nineteen faculty surgeons of the UT Southwestern Department of Plastic Surgery performed these operations from January 2008 through January 2011 at facilities associated with UT Southwestern Medical Center (Parkland Memorial Hospital, St. Paul University Hospital, Zale Lipshy University Hospital, and the Outpatient Surgery Center; Table 1).

The present study included patients who underwent surgery at the Outpatient Surgery Center, which is part of UT Southwestern St Paul University Hospital. Inpatients and patients who underwent surgery at other facilities were excluded from this study. Patient charts containing < 30 days of follow-up documentation also were excluded. Because this study involved only de-identified data, informed consent was not obtained. Patient charts were reviewed for (1) preoperative antibiotic prophylaxis, including antibiotic type and the timing and duration of administration; (2) use of postoperative antibiotic prophylaxis, including antibiotic type and duration of administration; and (3) the occurrence of complications during a 30-day follow-up period. Information on topical antibiotics and antibiotic irrigation solutions was not considered in this study. Wound complications were defined as infection, necrosis, hematoma, seroma, dehiscence, erythema, delayed wound healing, and any other wound problem noted by the surgeon. If a patient experienced any of these problems, he or she was regarded as having a complication.

A total of 467 patients (432 women, 35 men) met the inclusion criteria for this study. The following preoperative patient characteristics were included in the analysis: gender, age, comorbidities, the procedures performed for the recorded surgery, details regarding preoperative antibiotics, and concomitant medications. Intraoperative reports were reviewed for information on barbed suture placement, blood pressure,

Table 2. Complication Rates According to Timing of Preoperative Administration of Antibiotics

	Minutes Before Administration, n (%)								
	>120	120-75	74-60	59-45	44-30	29-15	14-0	>0[a]	NA
Women[b]	4 (5.26)	5 (6.58)	5 (6.58)	4 (5.26)	24 (31.6)	14 (18.4)	7 (9.21)	2 (2.63)	11 (14.5)
Men[c]	1 (14.3)	1 (14.3)	0 (0)	1 (14.3)	0 (0)	1 (14.3)	2 (28.6)	0 (0)	1 (14.3)
Total[d]	5 (6.02)	6 (7.23)	5 (6.02)	5 (6.02)	24 (28.9)	15 (18.1)	9 (10.8)	2 (2.41)	12 (14.6)

Abbreviation: NA, data not available.
[a]The >0 category is defined as patients receiving the first dose of prophylactic antibiotics at the time of incision or perioperatively.
[b]n = 76.
[c]n = 7.
[d]N = 83.

body temperature, implant type, and duration of surgery and anesthesia. Postoperative notes were reviewed for length of hospital stay, blood pressure, body temperature, drain placement and duration, and postoperative prophylactic antibiotics. Clinical follow-up notes were appraised for complications, specifically flap complications and wound complications. Data pertaining to the following comorbidities also were obtained: diabetes, smoking status, hypertension, coronary artery disease, other cardiovascular problems, chronic obstructive pulmonary disease, other pulmonary problems, renal disease, cancer, and history of deep vein thrombosis or pulmonary embolism.

Patients were grouped according to the timing of preoperative antibiotic administration (Table 1) and were subgrouped by the interval between antibiotic administration and the first incision (Table 2). Patients also were grouped according to whether they received postoperative prophylactic antibiotics. Complication rates were compared to determine whether postoperative prophylactic antibiotic administration impacted the rates.

Statistical Analysis

Odds ratios (ORs) were calculated by means of 2-by-2 frequency tables and were considered significant if the 95% confidence interval (CI) did not include 1.00. Significance was defined as $P < .05$.

RESULTS

The mean age of the study population was 49.5 years (range, 16-79 years). All 467 patients received preoperative prophylactic antibiotics. Of these, 217 patients (46.4%) received antibiotics between 29 and 15 minutes or between 44 and 30 minutes before the first surgical incision (Table 1). Preoperative antibiotics included cefazolin (384 patients), clindamycin (4 patients), levofloxacin (6 patients), and vancomycin (18 patients); antibiotic names were not documented in the charts of 56 patients.

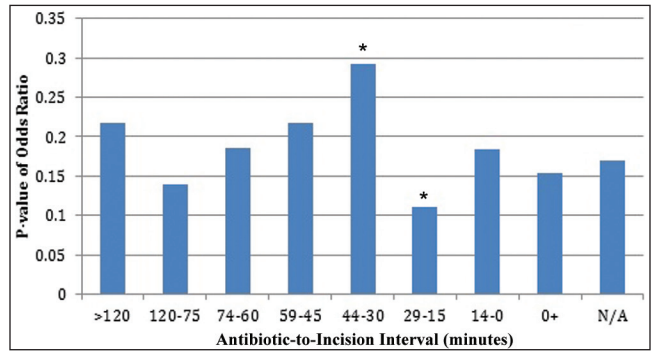

Figure 1. Comparison of *P* values describing the odds ratios for each time interval (from antibiotic administration to the first incision) vs any complication. The *P* values corresponding to 44 to 30 minutes and 29 to 15 minutes differed significantly ($P = .001$).

The 83 patients in the study group who experienced a complication were subgrouped according to timing of preoperative prophylactic antibiotics (Table 2). The highest rate of complications occurred among the 82 patients who received antibiotics between 44 and 30 minutes before the first incision; there were 24 occurrences of wound problems (24 of 83 complications; 28.9%). The second highest rate of complications was in the group of 135 patients who received antibiotics between 29 and 15 minutes before surgery. Of these, 15 experienced a complication (15 of 83 complications; 18.1%).

ORs were calculated to detect whether the interval between antibiotic administration and the first incision was associated with the complication rate. No time period was a significant predictor of complications, so the *P* values for the ORs were compared within each period (Figure 1). A significant difference was detected for 44 to 30 minutes vs 29 to 15 minutes ($P = .001$).

Subsequently, the patients were subgrouped into those receiving antibiotics from >120 to 30 minutes before surgery (group 1) and those receiving antibiotics from 29 to

Table 3. Comorbidity Prevalence in the Study Population[a]

Comorbidity	No. of Patients
Diabetes	12
Smoker, former	81
Smoker, current	27
Hypertension	99
Coronary artery disease	3
Other	66
COPD	2
Other Pulmonary	47
Renal	13
Cancer	110
DVT/PE	4

Abbreviations: COPD, chronic obstructive pulmonary disease; DVT/PE, deep vein thrombosis or pulmonary embolism.
[a]Patients were counted separately for each comorbidity: 110 complications were associated with cancer, and 99 were associated with hypertension, making these the most and second-most prevalent comorbidities, respectively.

Table 4. Effects of Comorbidities on Complication Rates[a]

Comorbidity	Odds Ratio	95% CI
Diabetes	1.08	0.11, 5.25
Smoking status		
Current smoker	0.96	0.32, 2.06
Former smoker	1.16	0.51, 1.80
Hypertension	1.64	0.88, 2.96
Coronary artery disease	11.10	0.57, 656.36
Other cardiovascular problem	0.96	0.41, 2.03
COPD	5.47	0.07, 430.60
Other pulmonary problem	0.77	0.26, 1.93
Renal	0.44	0.01, 3.09
Cancer	0.60	0.28, 1.18
DVT/PE	1.81	0.03, 22.93

Abbreviations: CI, confidence interval; COPD, chronic obstructive pulmonary disease; DVT/PE, deep vein thrombosis or pulmonary embolism.
[a]No comorbidity was significantly associated with complications because the confidence interval for each included 1.

>0 minutes (group 2) before surgery. The >0 time point corresponded to administration of the first dose of prophylactic antibiotics at the time of incision or perioperatively. A comparison of ORs indicated that group 2 experienced significantly fewer complications than group 1 ($P = .003$). Therefore, the risk of wound complications was significantly lower for patients whose antibiotic was administered 29 to >0 minutes before the first incision.

Comorbidities were abstracted from patient charts and assessed for associations with complications (Table 3). Patients were counted separately for each comorbidity. Of the 464 comorbidities among the study population, cancer (any form) was the most prevalent, affecting 110 patients (23.7%), followed by hypertension, accounting for 99 comorbidities (21.3%). None of the comorbidities predicted whether a complication would occur (Table 4), because the range of values encompassed by the 95% CI for each OR included 1.

The rates for each type of complication are summarized in Table 5. Wound complication was the most common type, affecting 73 of 468 patients (15.6%). Complication rates stratified by type of surgery are listed in Table 6. After eliminating skin grafting complications (n = 3), the highest complication rate was associated with excision of excessive skin tissue (26 of 75 patients; 34.7%). Skin grafting complications were omitted from the analysis because the sample size was small and could skew the data toward a procedure that did not accurately reflect the patient population used throughout the study.

Of the 83 study patients who experienced at least 1 complication, 51 (61.4%) received postoperative prophylactic antibiotics (OR, 0.73; 95% CI: 0.24, 1.22; Table 7). When stratified by type of complication, the complication rates were similar for the 153 patients who did not receive postoperative prophylactic antibiotics and the 315 patients who did (Table 8). This indicates that postoperative antibiotic use does not decrease the risk of complications. The overall complication rate for patients receiving postoperative prophylactic antibiotics was 16.2% (51 of 315), and the overall complication rate for patients not receiving postoperative prophylactic antibiotics was 20.9% (32 of 153).

DISCUSSION

In this retrospective review, we evaluated the timing of preoperative antibiotic administration and the use of postoperative antibiotics in relation to complications in an outpatient plastic surgery population. The purpose of preoperative antibiotic treatment is to "reduce intraoperative contamination to levels where it does not overwhelm the patient's defenses."[3] However, the best time to administer antibiotic prophylaxis remains debatable in the plastic surgery community.

The Centers for Disease Control and Prevention recommends administering most prophylactic antibiotics 1 hour before the first incision.[8] Dellinger[6] reported similar infection rates in a study of 1922 patients who underwent primary,

Table 5. Rates of Specific Complications Among the Study Population[a]

	Patients, n (%)	
Complication	Yes	No
Venous thromboembolism	2 (0.43)	466 (99.6)
Wound problem	73 (15.6)	395 (84.4)
Infection	18 (3.85)	450 (96.2)
Dehiscence	15 (3.21)	453 (96.8)
Erythema	32 (6.84)	436 (93.2)
Necrosis	7 (1.50)	461 (98.5)
Seroma	22 (4.70)	446 (95.3)
Hematoma	5 (1.07)	463 (98.9)
Delayed wound healing	7 (1.50)	461 (98.5)

[a]Each complication was recorded separately. A wound problem was defined as any problem that was not one of the ones listed here.

Table 6. Surgery Type and Complication Rates[a]

	Patients, n (%)	
Surgical Procedure	Total	With ≥1 Complication
Delayed breast prosthesis	94	5 (5.32)
Suction-assisted lipectomy	173	24 (13.9)
Excision of excessive skin tissue	75	26 (34.7)
Breast reconstruction	17	5 (29.4)
Excised skin, abdomen	84	17 (20.2)
Muscle skin graft, trunk	2	1 (50.0)
Removal of skin wrinkles	24	5 (20.8)
Muscle skin graft, arm	1	0 (0)

[a]A total of 470 patients are listed because 3 patients underwent multiple surgeries at the same time and the data could not be separated.

nonemergency total hip arthroplasty when antibiotic administration occurred between 60 and 30 minutes prior to initial incision vs between 30 and 0 minutes prior. However, a slightly lower infection rate was noted for hip surgery patients whose antibiotic was administered less than 30 minutes preoperatively vs 120 to 60 minutes preoperatively.[6] Weber et al[9] investigated 3836 consecutive surgical procedures in visceral, vascular, and traumatology division of general surgery and found that prophylactic antibiotics are most effective when administered between 59 and 30 minutes before the incision, or more specifically, between 59 and 45 minutes beforehand. In a recent publication, the SCIP reported that patients who received antibiotic prophylaxis ≤2 hours before the first incision had a much lower rate of SSIs than patients who received it >2 hours before or >3 hours after the incision.[10] Steinberg et al[11] examined 4363 randomly selected cardiac, hip/knee arthroplasty, and hysterectomy surgeries and reported that antibiotic administration within 60 minutes before surgery was predictive of a lower complication rate, but that patients who received antibiotics within 30 minutes before the incision had the lowest risk. Specifically, this study found that the SSI rate was 1.6% when antibiotics were given within 30 minutes before surgery and 2.4% when antibiotics were given between 60 and 31 minutes before surgery.[11] The SCIP currently recommends that prophylactic antibiotics be administered ≤60 minutes before surgery for all agents except vancomycin and floxacins, for which ≤120 minutes prior is the recommendation.[10]

The effectiveness of antibiotic prophylaxis in plastic surgery patients is not clear, and antibiotics may be unnecessary because most cases correspond to clean-contaminated surgical wounds.[1,12-15] Perrotti et al[15] reported that antibiotic administration by aesthetic surgeons is widespread, but only limited scientific evidence supports this practice. Baran et al[1] assessed wound infection rates during a 6-year study and reported no difference between patients treated with antibiotics and those who received placebo. Antimicrobial prophylaxis had no effect on SSIs in

Table 7. Complications vs Postoperative Prophylactic Antibiotics in the Study Population[a]

	No. of Patients With ≥1 Complication	
Antibiotic Prescribed	Yes	No
Yes	51	264
No	32	121

[a]Odds ratio, 0.73; 95% confidence interval: 0.24, 1.22. Because the interval includes 1, the complication rate was not affected by administration of postoperative antibiotics.

Table 8. Complication Rates for Patients Who Did Not Receive Postoperative Antibiotics[a]

Complication	Odds Ratio	95% CI
Venous thromboembolism	0.99	0.98, 1.00
Wound problem	1.19	0.67, 2.06
Infection	0.80	0.22, 2.44
Dehiscence	1.87	0.56, 6.01
Erythema	1.69	0.75, 3.70
Necrosis	5.36	0.86, 56.7
Seroma	0.60	0.17, 1.74
Hematoma	1.40	0.12, 12.3

[a]Complication rates were compared for these patients (n = 153) and those who did receive postoperative antibiotics (n = 315). Because the confidence interval (CI) includes 1 for each complication, the administration of postoperative antibiotics did not impact the rate of any specific complication.

plastic surgery cases of the breast, head and neck, or hand and upper extremities.[12] In contrast, Platt et al[13] investigated elective inguinal herniorrhaphy, femoral herniorrhaphy, mastectomy, lumpectomy, excisional breast biopsy, axillary-node dissection, and reduction mammaplasty and reported that perioperative antibiotics significantly reduced wound infection rates vs placebo. Mirzabeigi et al[7] suggested that the lowest rates of infection in breast augmentation cases occurred when patients received only preoperative prophylactic antibiotics compared with patients receiving preoperative antibiotics and 24 hours of postoperative antibiotics or those receiving preoperative antibiotics and 5 days of postoperative antibiotics.

Currently, no consensus guidelines exist for antibiotic prophylaxis in plastic surgery. When factors such as foreign materials (eg, implants and prostheses), lengthy operations, and extensive procedures are considered, recommendations for antibiotic treatment become even more complicated.[9] Because the literature on antibiotics in aesthetic surgery is scant, most plastic surgeons defer to standards for other specialties' clean-contaminated cases that suggest prophylactic preoperative antibiotics be discontinued within 24 hours after the first incision.[14]

In our study, 39 (18.0%) of the 217 patients who received prophylactic antibiotics 44 to 15 minutes before surgery experienced at least 1 complication. Patients who received antibiotics during this period represented 46.4% of the study population. Therefore, this interval accounted for 47.0% of all recorded complications (39 of 83 patients). In comparison, 93 (19.9%) of our 468 patients received antibiotics within the Centers for Disease Control and Prevention's guideline of ≥60 minutes preoperatively, and 16 (17.3%) of them experienced at least 1 complication. Therefore, this time interval accounted for 19.3% of all recorded complications (16 of 83 patients). These results coincide with SCIP data indicating that patients treated with antibiotics within 60 minutes before the first incision, and especially within 30 minutes prior, had lower rates of SSIs than patients treated ≤2 hours before the initial incision, and had much lower rates than patients given antibiotics >3 hours after or >2 hours before surgery.[3]

Because there were no significant differences in complication rates between any of the time intervals analyzed in our study, it appeared that the timing of preoperative antibiotic administration had little impact on complication rates. However, when our patients were grouped into 2 longer preoperative periods (antibiotic administration >30 minutes before surgery and ≤29 minutes before surgery), a significant difference in complication rates was noted ($P = .003$ by OR comparison). These data seem to indicate that the risk of complications is lower when antibiotics are administered very close to the time of initial incision. If confirmed, these findings support previous work by Dellinger[6] and the SCIP.[10]

In our study, complication rates were similar for the 153 patients who did not receive postoperative prophylactic antibiotics the 315 patients who did receive them. Of the 83 patients who experienced complications, 51 (61.4%) received postoperative prophylactic antibiotics. The 95% CI associated with the OR calculated for this comparison included 1, which indicates that complication rates were not significantly affected by postoperative antibiotic administration. Consistent with these findings, Perrotti et al[15] examined 10 types of aesthetic surgery, in which >50% of patients received postoperative antibiotics, and reported that the rationale for this prophylaxis was unsubstantiated. However, some trends have indicated that exposure to postoperative antibiotics decreases complication rates, albeit not significantly.[1] Specifically, fewer instances of wound hematoma, erythema, dehiscence, and wound problems have been noted with antibiotic administration.[15] Findings from our retrospective review are consistent with results of other studies.[6,7,15] We suggest that postoperative antibiotic prophylaxis is unnecessary if antibiotics have been administered preoperatively.

This study has several limitations. All data were based on physician reporting, and thus the classification of certain wounds varied. Moreover, there were some discrepancies in reporting the timing of antibiotic administration. For 72 patients (15.4%), the timing of preoperative antibiotic administration was not recorded; rather, it was merely noted that an antibiotic was administered before surgery. This issue will need to be addressed to ensure compliance with upcoming Affordable Care Act guidelines.

In this retrospective review, it was not possible to accurately document an SSI vs a wound problem unless a gross infection occurred. Also, many patients were prescribed antibiotics without having culture confirmation of an infection. Furthermore, we were not able to obtain American Society of Anesthesiologists scores or wound classes from patients' charts; these are primary predictors of SSI occurrence. We did not consider the role of drains in relation to antibiotic administration and the potential for infection. Nor did we identify the duration of postoperative antibiotic treatment. Antibiotics typically were prescribed for the first postoperative week, but treatment may have been extended until drains were removed. These limitations could be avoided in a well-designed prospective study.

CONCLUSIONS

The effectiveness of prophylactic antibiotics was examined in an outpatient plastic surgery setting. Administration of prophylactic antibiotics between 29 and 0 minutes before the first incision was associated with a lower rate of complications than antibiotic treatment ≥30 minutes before surgery. Postoperative administration of antibiotics did not

result in lower morbidity rates than preoperative administration alone, and these drugs are associated with inherent risks. Prospective studies in the plastic surgery setting are warranted to clarify the utility of antibiotics, particularly in surgical cases involving implants and drains.

Disclosures

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