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Antibiotic Prophylaxis in Uncontaminated Neck Dissection

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Objectives/Hypothesis: To describe our institution's experience with antibiotic prophylaxis in uncontaminated neck dissection and to identify risk factors associated with postoperative wound infection.

Study Design: Retrospective chart review.

Methods: Between April 2006 and June 2010, 244 patients underwent 273 uncontaminated neck dissections at a single tertiary care center. Patient factors, operative details, and postoperative complications were recorded. Patients were separated into three groups: no prophylactic antibiotics, intraoperative antibiotics only, and intra- and postoperative antibiotics.

Results: Wound infections occurred after nine of the 273 procedures (3.3%). All of the wound infections occurred in patients receiving intraoperative antibiotics only (4 of 157) or intra- and postoperative antibiotics (5 of 75) ($P = .11$). The development of a wound infection was not associated with age, sex, history of tobacco and alcohol use, history of head and neck surgery, or history of radiation or chemotherapy. Wound infection was independently associated with operative time (adjusted odds ratio, 1.35; 95% confidence interval, 1.07–1.71; $P = .011$, for each additional hour of surgery) and with radical or extended neck dissection (adjusted odds ratio, 14.61; 95% confidence interval, 2.37–90.01, $P = .004$).

Conclusions: Our data did not support the use of antibiotic prophylaxis in routine uncontaminated neck dissection. Prophylactic antibiotics, however, may be indicated for more extensive lymphadenectomy procedures.

Key Words: Antibiotics, prophylaxis, neck dissection, clean, uncontaminated.

Level of Evidence: 4.

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INTRODUCTION

The efficacy of perioperative prophylactic antibiotics in preventing postoperative wound infections after clean-contaminated head and neck surgery where the aerodigestive tract is violated has been clearly established in clinical trials.[1–3] Conversely, the infection rate after clean head and neck procedures such as parotidectomy, thyroidectomy, and submandibular gland excision is very low and antibiotic prophylaxis is unnecessary.[4] The benefit of prophylactic antibiotics for clean, uncontaminated neck dissection is less clear. Few studies have focused on examining the rate of postoperative wound infection after clean neck dissection. One study showed a lower rate of postoperative wound infection in patients receiving perioperative prophylactic antibiotics compared to those who did not receive antibiotics, but the difference was not statistically significant.[5] Another study demonstrated a benefit for 24-hour perioperative antibiotics compared to no antibiotics,[6] but the conclusions were questioned because the rate of infection in those not receiving antibiotics was much higher than other published infection rates after clean head and neck surgery.[7] A third group compared perioperative antibiotics for 24 hours to 4 to 5 days of perioperative antibiotics and found no benefit for longer-term prophylaxis.[8]

Based on this evidence, some have advocated the routine use of perioperative prophylactic antibiotics for more extensive clean, uncontaminated head and neck procedures.[9] Factors associated with higher postoperative wound infection rates include poor nutritional status, tobacco and alcohol consumption, prior radiotherapy, prior chemotherapy, prior tracheotomy, major resections with flap reconstruction, duration of surgery, and tumor stage.[9–11] We performed a retrospective chart review of patients undergoing neck dissections in which the aerodigestive tract was not violated. Specifically, we sought to describe our institution's recent experience with antibiotic prophylaxis in uncontaminated neck dissection and to identify risk factors associated with postoperative wound infection.

MATERIALS AND METHODS

After obtaining institutional review board approval, we reviewed the records of all patients who underwent clean, uncontaminated neck dissection at the University of Pittsburgh Medical Center between April 1, 2006 and June 21, 2010. We reviewed both inpatient and postoperative outpatient records for each patient. Patients who underwent concomitant clean-contaminated procedures such as tracheotomy, composite

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resection, and laryngectomy were excluded. We also excluded patients in whom the aerodigestive tract was entered during neck dissection. Patients who underwent concomitant clean procedures such as parotidectomy or thyroidectomy were not excluded. In addition, we did not exclude patients who underwent direct laryngoscopy and biopsy, with or without esophagoscopy (DLB±E). When performed, it is our practice to do these procedures before prepping and draping for the neck dissection.

Data were collected concerning patient age at surgery, sex, tobacco and alcohol use, comorbid conditions, history of head and neck surgery, presence of tracheostomy, history of chemoradiation therapy, type of neck dissection, levels of the neck dissected, type of concomitant surgery, type and duration of perioperative antibiotics, placement and number of surgical drains, operative time, length of hospital stay, development of postoperative complications, and antibiotic treatment of complications. Types of neck dissection included selective, modified radical, radical, and extended neck dissection. Extended neck dissection included cases with additional structures removed beyond those removed with radical neck dissection. Patients were stratified into three groups: no prophylactic antibiotics, intraoperative antibiotics only, and intra- and postoperative antibiotics.

The wound grading scale developed by Johnson et al. was used to assess for postoperative wound infection.[12] Infection was defined as purulent drainage either spontaneously or by incision and drainage, with or without cellulitis or fistula, requiring antibiotic therapy. Wound dehiscence or ischemic necrosis of wound edges requiring local care was not considered as infection. Erythema, increased warmth, edema, and induration of the wound were not considered as infection. Intraoperative antibiotics were defined as antibiotics starting before surgery and continued intraoperatively but not postoperatively. Perioperative antibiotics were defined as those starting before surgery and continued postoperatively for a total period of 24 hours or more.

Data were entered into an Excel spreadsheet (Microsoft Corp., Redmond, WA). Statistical analysis was performed using Stata SE 11.1 software (StataCorp, College Station, TX). Univariate analysis was performed using Student t tests, one-way analysis of variance, and χ^2 tests. Multivariate analysis was conducted using logistic regression models. All tests were performed using a two-sided alpha level of .05 for statistical significance.

RESULTS

Two hundred seventy-three uncontaminated neck dissection procedures in 244 patients between April 1, 2006 and June 21, 2010, were identified and analyzed. An additional five procedures did not have adequate follow-up data to determine the presence or absence of postoperative wound infection and were excluded from the study. No antibiotics were given in 41 procedures, intraoperative antibiotics were given in 157 procedures, and perioperative antibiotics were given in 75 procedures. Cefazolin was given in 177 cases, clindamycin was given in 29 cases, ampicillin/sulbactam was given in 22 cases, vancomycin was given in two cases, ampicillin was given in one case, and piperacillin/tazobactam was given in one case. Thirty of the 75 patients receiving perioperative antibiotics were given antibiotics for more than 24 hours. Other than age at the time of surgery, demographic, exposure, and neck dissection characteristics were similar for all three groups (Table I). Patients receiving more doses of antibiotics tended to be slightly older ($P = .028$).

Wound infections occurred after nine of the 273 procedures (3.3%). All of the wound infections occurred in patients receiving intraoperative antibiotics (4 of 157) or perioperative antibiotics (5 of 75) ($P = .11$). Eight of the nine wound infections occurred in patients who received cefazolin, and one occurred in a patient who received vancomycin; none occurred in those who received ampicillin/sulbactam or clindamycin. There was a trend suggesting a higher rate of infection after gram-positive prophylaxis only (cefazolin, vancomycin, or ampicillin) versus broader spectrum gram-positive, gram-negative, and anaerobic coverage (ampicillin/sulbactam, clindamycin, or piperacillin/tazobactam), but this finding was not statistically significant ($P = .10$). In the cases in which cultures were performed, wound cultures revealed methicillin-resistant *Staphylococcus aureus*, *Morganella morganii*, *Proteus mirabilis*, and *Pseudomonas aeruginosa*.

The development of a wound infection was not associated with age, sex, ethnicity, tobacco use, alcohol use, history of head and neck surgery, history of head and neck radiation, history of chemotherapy, total number of neck levels dissected, or number of drains placed during surgery. Univariate analysis revealed that the development of wound infection was associated with radical or extended neck dissection, local or pedicled flap closure, and increased operative time (Table II). Concomitant head and neck procedures were performed with almost 70% of the neck dissections (Table III). The mean operative time for cases with concomitant procedures was significantly longer (4.37 hours vs. 2.35 hours, $P < .0001$). Analysis of cases undergoing concomitant procedures revealed wound infection development to be associated with local or pedicled flap closure but not with DLB±E, mediastinal dissection, parotidectomy, skin excision, submandibular gland excision, or thyroidectomy.

Dissimilar demographic variables and those associated with postoperative wound infection in the univariate analysis were included in a logistic regression model to estimate adjusted odds ratios (ORs). Wound infection was associated with radical or extended neck dissection (adjusted OR, 14.61; 95% confidence interval [CI], 2.37–90.01; $P = .004$) and operative time (adjusted OR, 1.35; 95% CI, 1.07–1.71; $P = .011$, for each additional hour of surgery). The need for local or pedicled flap closure (adjusted OR, 3.52; 95% CI, 0.70–17.79; $P = .128$) was not associated with postoperative wound infection after adjusting for patient age, neck dissection type, and operative time.

Other common complications included seroma (3.3%), chyle leak (2.9%), hematoma or hemorrhage (1.8%), respiratory failure (1.8%), vocal fold paralysis (1.5%), and wound or flap dehiscence (1.5%). Only one of the nine patients with a postoperative wound infection experienced a second complication or adverse event. The overall mean length of stay in the hospital after surgery was 3.0 days. The mean length of stay for those who developed wound infections was longer at 4.6 days, but

TABLE I.
Demographic, Exposure, and Neck Dissection Characteristics for 273 Uncontaminated Neck Dissection Procedures (2006–2010).

Characteristic	No. of Patients (%)								*P* Value
	All (N = 273)		No Antibiotics (n = 41)		Intraoperative Antibiotics (n = 157)		Perioperative Antibiotics (n = 75)		
Mean age, yr	59.6		53.6		60.5		61.2		.028*
Sex									
Male	187	(68.5)	23	(56.1)	108	(68.8)	56	(74.7)	.11†
Female	86	(31.5)	18	(43.9)	49	(31.2)	19	(25.3)	
Ethnicity									
Caucasian	256	(94.8)	38	(92.7)	146	(93.0)	72	(96.0)	.61†
Black	12	(4.4)	2	(4.9)	7	(4.5)	3	(4.0)	
Hispanic	3	(1.1)	0	(0.0)	3	(1.9)	0	(0.0)	
Other	2	(0.7)	1	(2.4)	1	(0.6)	0	(0.0)	
Tobacco use‡									
Never	111	(43.0)	18	(50.0)	64	(42.4)	29	(40.9)	.65†
Ever	147	(57.0)	18	(50.0)	87	(57.6)	42	(59.1)	
Alcohol use‡									
Never/rare	122	(50.8)	21	(61.8)	64	(45.7)	37	(56.1)	.15†
Current	118	(49.2)	13	(38.2)	76	(54.3)	29	(43.9)	
History of H&N surgery‡									
No	71	(26.2)	11	(27.5)	41	(26.1)	19	(25.7)	.98†
Yes	200	(73.8)	29	(72.5)	116	(73.9)	55	(74.3)	
History of H&N radiation therapy									
No	208	(76.2)	31	(75.6)	133	(78.3)	54	(72.0)	.57†
Yes	65	(23.8)	10	(24.4)	34	(21.7)	21	(28.0)	
History of chemotherapy									
No	226	(82.8)	34	(82.9)	131	(83.4)	61	(81.3)	.93†
Yes	47	(17.2)	7	(17.1)	26	(16.6)	14	(18.7)	
Neck dissection type									
Selective	206	(75.5)	31	(75.6)	116	(73.9)	59	(78.7)	.88†
Modified radical	50	(18.3)	8	(19.5)	32	(20.4)	10	(13.3)	
Radical	11	(4.0)	2	(4.9)	6	(3.8)	3	(4.0)	
Extended	4	(1.5)	0	(0.0)	2	(1.3)	2	(2.7)	
Other/unknown	2	(0.7)	0	(0.0)	1	(0.6)	1	(0.6)	

*One-way analysis of variance.
†χ^2 test.
‡Tobacco use was not documented for 15 procedures. Alcohol use was not documented for 33 procedures. History of head and neck surgery was not documented for two procedures.
H&N = head and neck.

the difference was not statistically significant, especially after adjusting for neck dissection type and operative time (unadjusted $P = .055$, adjusted $P = .47$). The mean length of stay for those developing any complication or adverse event was significantly longer at 5.4 days ($P < .0001$).

DISCUSSION

This study was performed to explore whether prophylactic antibiotics decrease the rate of postoperative wound infection in patients undergoing uncontaminated neck dissection. Given the retrospective design of this study, the results may be subject to selection and misclassification bias. Older patients in our series were more likely to receive antibiotics. It is possible that surgeons elected to prescribe antibiotics to older individuals because they were perceived to be less healthy. To our knowledge, age has not been implicated as a major risk factor for the development of wound infection after head and neck oncologic surgery.[9,10,13,14] Nevertheless, we adjusted for patient age in our multivariate analysis. The types of neck dissection performed potentially may have been misclassified owing to the large number of descriptors that have been used throughout the history of neck dissection (e.g., functional, commando, etc.). We attempted to mitigate this potential bias by corroborating operative reports with the labeled specimens in the pathology reports. More importantly, underreporting of complications in the postoperative outpatient records may have led to an underestimate of the wound infection rate. Patients with incomplete postoperative records and those who received postoperative care outside of our institution were excluded from the analysis.

TABLE II.
Variables Associated with Postoperative Wound Infection by Univariate Analysis in 273 Uncontaminated Neck Dissection Procedures (2006–2010).

Characteristic	No. of Patients (%)						*P* Value
	All (N = 273)		No Wound Infection (n = 264)		Wound Infection (n = 9)		
Neck dissection type							
Selective	206	(75.5)	201	(76.1)	5	(55.6)	.006*
Modified radical	50	(18.3)	49	(18.6)	1	(11.1)	
Radical	11	(4.0)	9	(3.4)	2	(22.2)	
Extended	4	(1.5)	3	(1.1)	1	(11.1)	
Other/unknown	2	(0.0)	2	(0.8)	0	(0.0)	
Local or pedicled flap closure							
No	233	(85.4)	229	(86.7)	4	(44.4)	<.001†
Yes	40	(14.6)	35	(13.3)	5	(55.6)	
Mean operative time, hr	3.74		3.64		6.70		<.001‡

*χ^2 test.
†χ^2 test. Not statistically significant ($P = .128$) by multivariate analysis after adjusting for age, neck dissection type, and mean operative time.
‡Student *t* test.

Previous studies have implicated a number of other risk factors for developing postoperative wound infection. These include poor nutritional status, tobacco and alcohol consumption, prior chemoradiation therapy, prior tracheotomy, and tumor stage. Nutritional status and tumor stage were not recorded in this study. The degree of tobacco and alcohol consumption was poorly recorded in the preoperative record for many patients. Very few patients undergoing uncontaminated neck dissection had prior tracheotomy. It is likely that this study was underpowered to demonstrate the effect of prior chemoradiation therapy or prior tracheotomy on the postoperative wound infection rate.

Neck dissection is a clean operation, and the expected rate of postoperative wound infection is low. Our overall infection rate fell within the predicted range of less than 3% to 5% for clean procedures established in the U.S. Centers for Disease Control and Prevention guidelines for preventing surgical site infections.[15] Many head and neck surgeons, however, believe that those undergoing neck dissection represent a distinct category of patients at higher risk for infection owing to a variety of factors such as poor nutritional status, tobacco and alcohol use, and prior chemoradiation therapy.[5,16] This view appears to be gaining in prevalence. In this series, only 15% of the procedures were performed with no antibiotic prophylaxis, whereas 52% of clean neck dissections performed at our institution between 1976 and 1989 were performed without antibiotics.[5] Moreover, 40% of our patients receiving perioperative antibiotics were given antibiotics for more than 24 hours, despite a large body of evidence—some from our own institution—suggesting that a prolonged course of antibiotic therapy does not offer any advantage compared with 24-hour regimens, even in clean-contaminated head and neck procedures.[8,12,17–21]

TABLE III.
Concomitant Head and Neck Surgical Procedures Performed During 273 Uncontaminated Neck Dissections (2006–2010).

Concomitant Procedure	No. of Patients	%*
None (neck dissection only)	85	31.1
Parotidectomy	63	23.1
Direct laryngoscopy, biopsy ± esophagoscopy	45	16.5
Local or pedicled flap reconstruction	40	14.7
Thyroidectomy	35	12.8
Skin excision	19	7.0
Submandibular gland excision	7	2.6
Mediastinal lymph node dissection	7	2.6
Other	15	5.5

*Some patients underwent multiple concomitant procedures.

This study does corroborate the concept that neck dissection patients who require more extensive surgery may be at higher risk for developing postoperative wound infections. This may be due to prolonged operative time such as those requiring flap closures. Neck dissection involves protracted exposure of the wound. The need for changes in the positioning of the patient's head and the saturation of drapes with blood may lead to breaches in the sterility of the surgical field. Patients with a higher burden of disease may also be at higher risk for postoperative wound infections. The rate of infection after radical neck dissection was higher despite having a shorter average operative time compared to the selective and modified radical neck dissection groups.

Ultimately, our study does not definitively answer whether perioperative prophylactic antibiotic administration significantly lowers the postoperative wound infection rate after clean neck dissection. The beta error was greater than .2 in this study. Based on our wound infection rate and those published in the literature, at least 600 patients would need to be recruited into a

randomized controlled trial. A potentially even greater number of patients would be needed to determine differences in infection rates after intraoperative versus 24-hour perioperative antimicrobial prophylaxis.

CONCLUSION

Our data did not support the use of antibiotic prophylaxis in routine uncontaminated neck dissection. Prophylactic antibiotics, however, may be indicated for more extensive lymphadenectomy procedures including radical neck dissection, extended neck dissection, or those requiring longer operative times.

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