ORIGINAL RESEARCH ARTICLE

PREVIOUS CHEMOTHERAPY AS A PREDICTOR OF WOUND INFECTIONS IN NONMAJOR HEAD AND NECK SURGERY: RESULTS OF A PROSPECTIVE STUDY

Nicolas Penel, MD,1,2 Charles Fournier,1,3 Danièle Lefebvre, MD,4 Micheline Roussel-DeVallez, MD,1,5 Jérôme Sarini, MD,1,6 Ahmed Kara, MD,6 Yann Mallet, MD,6 Jean-Louis Lefebvre, MD6

1 Hygiene unit, Centre Oscar Lambret, Lille, France
2 General Oncology Department, Centre Oscar Lambret, 3, rue F Combemale, Lille, 59020 France.
E-mail: n-penel@o-lambret.fr
3 Biostatistic Unit, Centre Oscar Lambret, Lille, France
4 Anesthesiology Department, Centre Oscar Lambret, Lille, France
5 Bacteriology Department, Calmette Hospital, University of Lille, Lille, France
6 Head and Neck Department, Centre Oscar Lambret, Lille, France

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Abstract: Background. The goal of this prospective study was to determine the incidence of wound infection (WI) after clean uncontaminated head and neck cancer procedures and after emergency tracheotomies.

Methods. Two hundred twelve clean procedures without tracheotomy or opening of mucosa (neck dissections, large skin resections, thyroidectomies, parotid gland resections, and explorative cervicotomies) were studied at Oscar Lambret Cancer Center over a 24-month period.

Results. WI rate was 6.6% (14 of 212). In a univariate analysis, only one variable was significantly related to the likelihood of WI: previous anticancer chemotherapy. All but one patient who had had previous chemotherapy demonstrated WI (14 of 15).

Conclusions. After previous chemotherapy, the WI rate in clean uncontaminated head and neck surgery was as high as 90%. In this case, antibiotic prophylaxis should be evaluated.


Keywords: head and neck cancer; chemotherapy; tracheotomy; wound infection; nosocomial infection

Wound infection (WI) is a major problem in head and neck cancer surgery. The development of WI may result in significant functional morbidity, poor cosmetic results, psychological trauma, prolonged hospital stay, and additional costs, and sometimes may delay postoperative radiation therapy.1 There is a body of evidence suggesting that delayed adjuvant treatment compromises the outcome for patients in terms of local control and overall survival.2

Incidence, risk factors, and consequences of WI in head and neck cancer surgery when opening the upper aerodigestive mucosa have been well documented.3–7 On the contrary, little is known about WI after clean procedures.

The purpose of this prospective study was first to determine WI incidence in head and neck can-
cer surgery and, second, to identify WI risk factors after clean procedures.

**PATIENTS AND METHODS**

Two hundred twelve consecutive clean procedures were performed between January 1997 and December 1998 in the Head and Neck Cancer Department at Oscar Lambret Cancer Center. Surgical procedures associated with tracheotomy or opening of the upper aerodigestive tract were excluded from this study.

Clean surgical procedures were performed while observing the general rules of sterility. All wounds were prepared with povidone-iodine (excluding cases of thyroid procedures) and irrigated with normal saline before closure. According to French recommendations, no prophylactic antibiotic was administered.8

For each clean surgical procedure, we recorded the following: main patient characteristics (sex, age), disease characteristics (histologic subtypes, previous treatments [chemotherapy, radiation therapy]), present surgical procedures (duration, large cutaneous excision associated, method of reconstruction, neck dissection associated), and wound characteristics.

The postoperative wound was evaluated daily and monitored until the end of the postoperative hospital stay. According to Johnson criteria, WI was defined as the presence of pus from the wound or the presence of an orocutaneous or pharyngocutaneous fistula regardless of origin (including flap failure). Bacteriologic results were not required for diagnosis of wound infection.9

Samples of aerobic and anaerobic cultures were collected from the infected wounds. Pathogens were identified by use of conventional taxonomic schemes.

Statistical evaluation was performed with the $\chi^2$ test and Yates corrected $\chi^2$ analysis for categorical data and Mann-Whitney test for continuous data. The level of significance was set at 5% ($p < .05$).

**RESULTS**

The study population consisted of 212 patients, with squamous cell carcinoma of the upper aerodigestive tract in 120 cases, other cancers in 54 cases, and benign tumors in 38 cases (Table 1). There were 68 women and 144 men. The mean patient age was 65.1 years (standard deviation, 8.9). No patient had neutropenia at the time of surgery.

Surgical procedures are described in Table 1. In 200 cases, the duration of procedures was less than 2 hours. The median postoperative hospital stay was 6 days (range, 3–21 days).

![Table 1. Locations and surgical procedures.](image-url)
The overall WI rate was 6.6% (14 of 212 procedures). No WI was associated with fistula. No WI was observed in case of benign tumor.

Bacteriologic analyses were performed in eight cases. Postoperative wound cultures revealed pathogens in eight cases: seven gram-positive cocci (six *Staphylococcus aureus* and one *Streptococcus agalactiae*) and one gram-negative bacteria (one *Klebsiella oxytoca*).

Squamous cell cancers were associated with the highest WI rate, but this difference was not statistically significant. WI rate varied according to surgical procedures: 0 of 14 explorative cervicotomies and parotidectomies, one of 50 thyroidectomies, 10 of 114 neck dissections, and three of 34 large cutaneous excisions. Univariate analysis identified only one risk factor of WI (Table 2): previous anticancer chemotherapy ($p < .00001$). All but one (14 of 15) patient who had had previous chemotherapy demonstrated WI.

**DISCUSSION**

In this study, the overall WI rate after clean procedures was 6.6%. Our study confirms that clean uncontaminated head and neck procedures (neck dissections, parotidectomies, thyroidectomies, submandibular gland excisions) are associated with very low postoperative WI rate. In three previous published retrospective studies, WI rates ranged between 0.7% and 6% and in a prospective study were 11.6% (Table 3). However, direct comparison of these results is not relevant because of different WI definitions and use of antibiotic prophylaxis in two studies. This study and the one by Mustafa and Tashin suggest that prospective studies were associated with a higher WI rate. Retrospective studies were associated with a lower WI rate because of methodologic underestimation.

We found no difference, in WI rates between different surgical procedures. A previous study suggested that neck dissections increased WI risk because of frequent head and neck repositioning, longer operative times, greater duration of drain placement, and saturation of the drapes with blood. This point was still controversial; other authors found no difference in WI rates after neck dissections compared with other clean uncontaminated procedures.
All but one patient, who had had previous chemotherapy, demonstrated WI. Previously, we found similar results for breast cancer procedures\(^1\) and for clean uncontaminated head and neck cancer procedures.\(^3\) On the contrary, this study and others\(^3,11,13\) suggested that previous radiation therapy had no deleterious impact on the WI rate whatever the surgical procedure was. Anticancer chemotherapy adversely affects the number and functions of neutrophils and macrophages (chemotaxis, phagocytosis, bactericidal activity) and B-cell and T-cell functions, resulting in diminished opsonizing activity, inadequate agglutination and lysis bacteria, and deficient neutralization of bacterial toxins. Consequently, patients with defects in cellular and humoral immunity and antibody production have increased susceptibility to pyogenic bacterial infections, even if they are not neutropenic. These adverse effects persist more than 6 months after the end of the chemotherapy.\(^14,15\) In our study, previous chemotherapy dramatically increased WI rate.

In these cases, causative pathogens were essentially gram-positive coccii. In this study, most WIs were monomicrobial and related to skin flora. On the contrary, WI after head and neck cancer surgery with opening of mucosa were polymicrobial because of anaerobes, coccii, gram-positive and gram-negative rods from oropharyngeal flora. So, there is good evidence to use antibiotic prophylaxis with gram-positive coverage (for example, clindamycin and gentamycin association) in clean uncontaminated procedures associated with a WI rate higher than 5% after previous chemotherapy in our experience. However, the potential benefits of prophylactic antibiotics must be compared with the possible side effects (hypersensitivity reactions, risk of selecting out resistant pathogens, increasing costs). Only a phase III controlled clinical trial comparing antibiotic prophylaxis and placebo could clearly confirm the efficacy of antibiotic prophylaxis in this situation.

We did not observe WI after benign tumor surgery. Squamous cell cancers were associated with the highest WI rate. Different studies suggest that squamous cell cancer induces inhibition of lymphocyte function and apoptosis in activated lymphocytes.\(^16–19\) Other studies show a high rate of malnutrition in these patients and a correlation between malnutrition and postoperative major complications.\(^20,21\)

Our results suggest that the Altemeier classification\(^22\) is not completely applicable to head and neck cancer procedures. New prospective studies, including nutritional status assessment, lymphocyte and neutrophil function analysis, microbial colonization, the role of previous chemotherapy, and the use of hematopoietic growth factors, are

<table>
<thead>
<tr>
<th>Authors</th>
<th>Study</th>
<th>Surgical procedures</th>
<th>n</th>
<th>WI rate with antibiotic prophylaxis</th>
<th>WI rate without antibiotic prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnson(^9)</td>
<td>Retrospective</td>
<td>Parotid gland resections; thyroidectomies; submandibular gland resections</td>
<td>438</td>
<td>3/438 (0.7%)</td>
<td>1/88 (1.1%)</td>
</tr>
<tr>
<td>Carrau(^10)</td>
<td>Retrospective</td>
<td>Neck dissections</td>
<td>192</td>
<td>13/192 (6%)</td>
<td>3/93 (3%)</td>
</tr>
<tr>
<td>Slattery(^11)</td>
<td>Retrospective</td>
<td>Parotid gland resections; thyroidectomies; submandibular gland resections; tracheotomies; neck dissections</td>
<td>483</td>
<td>3/438 (0.7%)</td>
<td>0/120</td>
</tr>
<tr>
<td>Mustafa(^12)</td>
<td>Prospective</td>
<td>Parotid gland resections; thyroidectomies; submandibular gland resections</td>
<td>60</td>
<td>7/60 (11.6%)</td>
<td>—</td>
</tr>
<tr>
<td>This study</td>
<td>Prospective</td>
<td>Parotid gland resections; thyroidectomies; submandibular gland resections; large skin resections; neck dissections</td>
<td>212</td>
<td>14/212 (6.6%)</td>
<td>—</td>
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necessary to precisely ascertain significant risk factors for WI in different head and neck cancer surgical procedures.3

REFERENCES