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Multivariate analysis of risk factors for postoperative wound infection following oral and oropharyngeal cancer surgery

Margita Belusic-Gobic [a], Arijan Zubovic [a, *], Robert Cerovic [a], Andrea Dekanic [b], Diana Marzic [c], Gordana Zamolo [b]

[a] Clinic for Maxillofacial Surgery, University Hospital Center Rijeka, (Chair: Assoc. Prof. Robert Cerovic, MD, DMD, PhD), Tome Strizica 3, 51000, Rijeka, Croatia
[b] Department of Pathology, Rijeka University School of Medicine, Rijeka, Croatia
[c] Clinic for Otorhinolaryngology, University Hospital Center Rijeka, Rijeka, Croatia

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ABSTRACT

Purpose: The goal of this study was to identify risk factors for wound infections in patients with oral cancer who underwent surgical procedures.
Materials and methods: This study included 195 patients who underwent surgical treatment of oral and oropharyngeal cancer over a 7-year period. Wound infection was defined as the occurrence of purulent content from the wound or as an appearance of exudate with signs of local infection and positive cultures taken from the wound. For every patient who was suspected to have a wound infection, a swab from the wound was taken, and microbiological analysis was performed. The patients were divided into 2 groups: patients with postoperative wound infections, and patients with postoperative wound infection.
Results: Wound infection was present in 155 patients (59%). Univariate analysis indicated that the following factors were significantly related to the occurrence of wound infection: gender, smoking, tumor localization, size and stage of the tumor, type of surgery, neck dissection, type of reconstruction, nasogastric sonde, gastrostomy and tracheotomy. On multivariate analysis, statistically significant predictors of wound infection were gender, tumor localization and type of reconstruction.
Conclusions: The occurrence of wound infection is high despite antibiotic prophylaxis. To minimize the risk of wound infection and for prompt recognition of risk factors, surgeons managing oral tumor patients should have a better understanding of the risk factors such as gender, tumor localization and type of reconstruction.

1. Introduction

Surgery is the main treatment in patients with oral and oropharyngeal cancer. After surgical treatment, the postoperative wound is exposed directly to bacteria from the mouth (Ma et al., 2012). The microbial flora of the oral cavity are rich and diverse, and can compromise normal wound healing and cause surgical site infection (Shigeishi et al., 2015). Wound infections are the largest single group of postoperative surgical complications, and are usually associated with increased morbidity and mortality, longer stay in hospital, high-cost medical expenses, and poor functional and cosmetic results. In clean surgical wounds, infection rates are low; on the other hand, in clean contaminated wounds, where oral surgery procedures take place, infection rates are higher (Sepehr et al., 2009; Sato et al., 2011; Ma et al., 2012). Antibiotic prophylaxis reduces the risk of postoperative infection dramatically in patients undergoing head and neck surgery, but there is still no consensus about the duration of antibiotic therapy and antibiotic choice (Fraioli et al., 2004; Penel et al., 2005; Sepehr et al., 2009; Liu et al., 2011; Man et al., 2011). Several predictive risk factors have been identified for wound infection after head and neck surgery (Lotfi et al., 2008; Shah et al., 2009; Lee et al., 2015; Shigeishi et al., 2015). In our previous study, we investigated different risk factors related to postoperative wound infection after oral cancer surgery by using univariate analysis (Belusic-Gobic et al., 2007). In the

* Corresponding author. Fax: +385 51 218 279.
E-mail address: arijan.zubovic@gmail.com (A. Zubovic).

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present study, we expand further our research of different risk factors by using both univariate and multivariate analysis.

2. Materials and methods

This study included 195 patients who underwent surgical treatment of oral and oropharyngeal cancer over the 7-year period (2009–2015) at the Clinic of Maxillofacial Surgery, Clinical Hospital of Rijeka (Rijeka, Croatia). The Clinical Hospital Center Rijeka institutional review board granted exempt status for the present study.

The extent of surgery included the following: excision of the tumor in all patients, resection of the mandible, neck dissection, and reconstruction of the defect if required. In some cases, the COMbined MAndibulectomy and Neck Dissection Operation (COMMANDO)/block-resection was performed. Tracheostomy was performed and a nasogastric tube was inserted. All patients received perioperative antibiotic prophylaxis on the day of surgery and at least until the drains were removed. The wound was checked daily, and signs of infection were observed. Wound infection was defined as the occurrence of purulent content from the wound or as the appearance of exudate with signs of local infection and a positive culture taken from the wound. For every patient who was suspected to have a wound infection, a swab from the wound was taken and microbiological analysis was performed.

The patients were divided into 2 groups: patients without postoperative wound infection, and patients with postoperative wound infection. Only patients with the identified microbiological pathogens from wound swabs and with the clinical signs of wound infection were classified in the group of patients with wound infection. These 2 groups of patients were examined and compared for any preoperative factors that could affect the occurrence of infections. The factors were divided into three groups: factors related to the patient, factors related to the tumor, and factors related to the surgery. The level of statistical significance was set at $p < 0.05$, with 95% confidence intervals. In all cases, a 2-tailed test was used. A statistically significant relation between the 2 binary variables was tested with the Fisher exact test. In the analysis of the differences in mean values (median) on a continuous, numerical variable between 2 categories of some nominal variable, the Mann–Whitney U test was used. In the analysis for differences between groups with the dependent variable, due to deviations from the normal distribution, the Friedman test was used. In the analysis of the differences in mean values (median) on a continuous numerical variable between more than 2 categories of some nominal variable, the Kruskall–Wallis test was used. The connection between string variables and the occurrence of infection were calculated using binary logistic regression, determining the odds ratio for the occurrence of infections. In the initial analysis, univariate logistic regression was used in order to show the correlation of a variable with the occurrence of the infection. After that, the variables (whose individual connection with the occurrence of infection showed statistically significant), were included in a joint logistic regression (multivariate analysis), and in that way overall predictive set of infection occurrence were obtained, taking into account interactions between individual variables. For statistical analysis, SPSS version 17.0 software was used (SPSS Inc., Chicago, IL, USA).

3. Results

Wound infection was present in 155 patients (59%). Patient-related characteristics are shown in Table 1. We observed that the frequency of wound infection was higher in male compared to female patients, and this result was statistically significant. The odds ratio 3.52 (95% CI: 1.75–7.07) showed that male patients have more than 3 times higher chances of acquiring an infection than female patients. The age of patients did not affect the incidence of wound infection. In patients who consumed alcohol compared to those who did not, the risk of getting an infection was more than 2 times higher (OR: 2.31; 95% CI: 1.25–4.25). Similarly, in patients who smoked, there was 2.4 times higher frequency of wound infection (OR: 2.4; 95% CI: 1.29–4.48). The blood type and the presence of other comorbidities that were individually tested (pulmonary disease, hypertension, cardiovascular disease, gastrointestinal disease and diabetes) were not statistically significant in regard to the occurrence of infection.

Table 1
Frequency of infection according to socio-demographic and behavioral characteristics of patients.

	Infection		No infection		Total		OR	95% CI
	n	(%)	n	(%)	n	(%)		
Sex								
Female	16	(35.6)	29	(64.4)	45	(100.0)		
Male	99	(66.0)	51	(34.0)	150	(100.0)	3.52	(1.75–7.07)
Age, yr								
<44	9	(52.9)	8	(47.1)	17	(100.0)		
45–54	30	(61.2)	19	(38.8)	49	(100.0)	1.40	(0.46–4.27)
55–64	34	(59.6)	23	(40.4)	57	(100.0)	1.31	(0.44–3.91)
65–74	37	(62.7)	22	(37.3)	59	(100.0)	1.50	(0.50–4.44)
>75	5	(38.5)	8	(61.5)	13	(100.0)	0.56	(0.13–2.41)
Alcohol								
No	29	(45.3)	35	(54.7)	64	(100.0)		
Yes	86	(65.6)	45	(34.4)	131	(100.0)	2.31	(1.25–4.25)
Smoking								
Yes	26	(44.1)	33	(55.9)	59	(100.0)		
No	89	(65.4)	47	(34.6)	136	(100.0)	2.40	(1.29–4.48)
Blood type								
A	46	(67.6)	22	(32.4)	68	(100.0)		
B	20	(58.8)	14	(41.2)	34	(100.0)	0.68	(0.29–1.60)
AB	4	(40.0)	6	(60.0)	10	(100.0)	0.32	(0.08–1.25)
0	42	(56.0)	33	(44.0)	75	(100.0)	0.61	(0.31–1.21)
Comorbidities								
No	45	(57)	34	(43)	79	(100.0)		
Yes	70	(60.3)	46	(39.7)	116	(100.0)	1.15	(0.64–2.05)

OR, odds ratio; CI, confidence interval.

The occurrence of infection according to the characteristics of the tumor is summarized in Table 2. We observed differences in the incidence of wound infection between patients whose tumor was localized in the anterior two-thirds of the tongue compared to those with a tumor of the base of the tongue (5 times higher risk), retromolar localization (3.27 times higher risk) and gingival tumor of the mandible (8 times higher risk). We found also that patients with T2, T3 and T4 tumor stage had statistically significantly higher chances for infection when compared to those with T1. The treatment-related characteristics are listed in Tables 3 and 4. We observed a statistically significant correlation between infection and surgical procedure. According to these results, patients who underwent the COMMANDO procedure had higher chances for infection than patients with only intraoral excision or with segmental resection of the mandible (OR: 41.11; 95% CI: 9.04–187.03). Patients with a resected mandible (marginal or segmental) had 5 times higher chances of wound infection (OR: 5.5; 95% CI 2.61–9.77). Moreover, a statistically significant correlation was observed between infection occurrence and neck dissection. On the other hand, there was no statistically significant correlation between infection and the swing of the mandible (OR: 0.34).

We observed a statistically significant connection between use of a nasogastric tube and infection. Only 12 patients after surgery were without a nasogastric tube, and they did not have a postoperative wound infection. The patients with a nasogastric tube had 10.05 times (OR, 95% CI: 1.30–77.89) higher wound infection

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