Journal of Cranio-Maxillo-Facial Surgery 44 (2016) 952–957

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Perioperative risk factors for postoperative pulmonary complications after major oral and maxillofacial surgery with microvascular reconstruction: A retrospective analysis of 648 cases☆

Denys J. Loeffelbein [a, *], Annette Julinek [a], Klaus-Dietrich Wolff [a], Eberhard Kochs [b], Bernhard Haller [c], Rainer Haseneder [b]

[a] Department of Oral and Maxillofacial Surgery, Technische Universität München, Germany
[b] Department of Anaesthesiology, Technische Universität München, Germany
[c] Institute of Medical Statistics and Epidemiology, Technische Universität München, Munich, Germany

ARTICLE INFO

Article history:
Paper received 22 January 2016
Accepted 9 May 2016
Available online 14 May 2016
Presentation: Preliminary data for this study were presented as a poster presentation at the Annual Meeting of the German Association of Oral and Maxillofacial Surgery in Stuttgart, Germany, June 2015.

Keywords:
Postoperative pulmonary complications (PPCs)
Risk factors
Oral and maxillofacial surgery

ABSTRACT

Background: Postoperative pulmonary complications (PPCs) are common and result in prolonged hospital stays, higher costs and increased mortality. However, data on the incidence and predictors of PPCs after major oral and maxillofacial surgery with microvascular reconstruction are rare.

This retrospective analysis identifies perioperative risk factors for postoperative pulmonary complications (PPCs) after major oral and maxillofacial surgery with microvascular reconstruction.

Methods: Perioperative data and patient records of 648 subjects were analyzed in the period of June 2007 to May 2013. PPCs were defined as pneumonia, atelectasis, pleural effusions, pulmonary embolism, pulmonary oedema, pneumothorax or respiratory failure.

Results: 18.8% of all patients developed PPCs. Patient-related risk factors for PPCs were male sex, advanced age, smoking, alcohol abuse, a body mass index >30, American Society of Anaesthesiologists grade higher than 2, pre-existent pulmonary diseases and preoperative antihypertensive medication. Among the investigated procedure-related variables, the length of the operation, the amount of fluid administration and blood transfusion and an impaired oxygenation index during surgery were shown to be associated with the development of PPCs. Using a multivariable logistic regression model, we identified a body mass index >30, American Society of Anaesthesiologists grade higher than 2 and alcohol abuse as independent risk factors for PPCs.

Conclusions: Several perioperative factors can be identified that are associated with the development of PPCs. Patients having one or more of these conditions should be subjected to intensified postoperative pulmonary care.

1. Introduction

Postoperative pulmonary complications (PPCs) are common and result in prolonged hospital stays, higher costs and increased mortality (Canet et al., 2010; Sabate et al., 2014). Depending on the type of surgery and patient collective, incidence rates for PPCs have been reported to lie between 3 and 38% (Ferguson et al., 2011; Johnson et al., 2007). Surgery in the head and neck area *per se* has been identified as a risk factor for the development of PPCs (Arozullah et al., 2000).

Microvascular free flap surgery is a proven technique and various areas have been tested as donor regions over the past forty years. In the recent past, the most frequently used free flaps in oral and maxillofacial surgery are the radial forearm– (RFFF), the fibular– and the anterolateral thigh (ALT) flap (Kansy et al., 2015). The fibula transplant is used for the reconstruction of bony or composite defects, whereas RFFFs or ALTs are used for soft tissue coverage (Wei et al., 1999). These transplants show the best results with respect to the quality of vessels and meet the demands of adequate

☆ This paper is based on and part of the doctoral thesis of Annette Julinek.

* Corresponding author. Department of Oral and Maxillofacial Surgery, Technische Universität München, Ismaninger Str. 22, D-81675 München, Germany. Tel: +49 89 4140 2929; fax: +49 89 4140 4993.
E-mail address: Denys.Loeffelbein@tum.de (D.J. Loeffelbein).

http://dx.doi.org/10.1016/j.jcms.2016.05.007
1010-5182/

functional and aesthetic reconstruction (Schrag et al., 2006). Nowadays, perforator-based free flaps have entered the field of microvascular surgery and are increasingly used in reconstructive procedures (Wallace et al., 2009), including head and neck reconstruction (Chang et al., 2013; Wolff et al., 2011). The downside of this technique is the extended time of surgery and anaesthesia because of the highly complex procedure of raising the transplant, performing microvascular anastomosis and reconstructing the generated defect.

Patients undergoing major surgery in the head and neck area with microvascular reconstruction suffer from various postoperative complications. Most of them involve transplant complications, functional and aesthetic problems (Kolokythas, 2010). We therefore need to minimize additional complications such as PPCs to relieve postoperative healing and to guarantee a specific general state of health of the patients.

The goal of this study has been to clarify perioperative risk factors for the development of PPCs after major oral and maxillofacial surgery with microvascular reconstruction in a high-volume medical centre.

2. Material and methods

The study design was reviewed and has been approved from an ethical and legal point of view by the ethical committee of the medical faculty of the Technische Universität München (registration number: 381/15). The need for patient informed consent was waived given the retrospective nature of the study.

2.1. Patient data

A total of 648 patients underwent major head and neck surgery with microvascular reconstruction at the Department of Oral and Maxillofacial Surgery of the Technische Universität München between 1st June 2007 and 31st May 2013. The only inclusion criterion was the need for a microvascular free flap in the head and neck area. Digital and non-digital departmental, hospital, operative and anaesthesia records were reviewed. In addition, radiography and/or CT chest scans of the patients were analyzed.

The following patient-related parameters were extracted: demographic data, weight, height, primary diagnosis (including tumour entity, UICC classification and tumour location), previous radiotherapy, comorbidities, American Society of Anaesthesiologists (ASA) grade, medication, alcohol and nicotine abuse, electrocardiogram and chest X-ray findings, haematocrit, number of blood platelets, partial thromboplastin time, prothrombin time, blood urea, creatinine, glutamate pyruvate transaminase and gamma-glutamyl transpeptidase.

The analyzed procedure-related parameters included time of surgery, type of microvascular flap, tracheotomy, placement of nasogastric tube, type of intraoperatively administered antibiotics, intraoperative donation of blood products (erythrocyte concentrates, fresh frozen plasma and platelet concentrates), total volume of intraoperative fluids, pH-value and oxygenation index at the beginning and at the end of the surgery.

All of the patients received immediate postoperative intensive care and were observed for a night in the post anaesthesia care unit (PACU) or when needed were transferred to the intensive care unit (ICU). Analyzed parameters of the postoperative period were length of stay at the PACU/ICU, the duration of supported ventilation and the total length of stay in hospital.

2.2. Definition of PPCs

PPCs were defined as dysfunction or identifiable diseases of the respiratory system that were clinically relevant and affected the clinical course and that occurred within the hospital stay. The diagnosis of PPCs was based on the clinical manifestations, radiological examination and laboratory tests. PPCs included pneumonia, atelectasis, pleural effusions, pulmonary embolism, pulmonary oedema, pneumothorax and respiratory failure. Prolonged mechanical ventilation, defined as more than 15 h postoperatively, or the need for re-intubation were also defined as PPCs if they were not necessary because of other indications (e.g. need for surgical revision).

2.3. Statistical analysis

The patients were divided into two groups for the presence or absence of PPCs as a dependent variable. Where appropriate, independent continuous variables were categorized based on clinical practice. For example, parameters of clinical chemistry were dichotomized according to the laboratory standard values used in our hospital. Quantitative data are summarized as means ± standard deviation unless otherwise indicated, whereas categorical data are given as absolute and relative frequencies. Student's t-test and the χ^2-test were used to examine differences between the two groups for continuously distributed and categorical variables, respectively. When data were not normally distributed, the Mann–Whitney U test was used. All significant variables from this univariate exploratory analysis were entered into a multivariable logistic regression analysis to identify those perioperative variables that independently predicted PPCs. All statistical tests were performed as two-sided and a local significance level of 5% was considered. IBM® SPSS® Statistics 22.0 software (SPSS®, Inc., Chicago, IL, USA) was used for statistical analysis.

3. Results

Out of 648 patients included in this study, 408 (63%) were male and 240 (37%) female. The median age of the patients was 61 years (range 11–97, standard deviation 12.7). The most frequent indications for the microsurgical procedures were squamous cell carcinoma ($n = 483$, 74.5%) and osteoradionecrosis and osteochemonecrosis of the jaws ($n = 44$, 6.7%).

Out of 648 patients, 122 developed PPCs (18.8%). The male gender was significantly associated with PPCs ($P = 0.012$, odds ratio (OR) = 1.75; Table 1). Of the 122 patients developing PPCs, 89 (72.9%) were male.

Patients who developed PPCs were significantly older (62.9 ± 10.1) than patients who did not develop PPCs (59.6 ± 13.1; $P = 0.009$). Patients between 60 and 69 years of age or more than 70 years of age had an increased risk of developing PPCs ($P = 0.036$, OR = 2.02; or $P = 0.019$, OR = 2.28; Table 1). Moreover, adipositas (patient body mass index >30) was significantly associated with an increased risk for PPCs ($P = 0.001$, OR = 3.24).

Patients who did not receive previous radiotherapy had a significantly increased risk for PPCs compared with patients who received previous radiotherapy ($P = 0.017$; OR = 0.40).

Patients with an ASA grade of 3 had a significantly increased risk for PPCs ($P < 0.001$, OR = 2.54) as did patients with a pulmonal comorbidity ($P = 0.005$, OR = 1.86). A pulmonal comorbidity was assumed to be existent, if a pre-existing specified diagnosis could be extracted from the patient records (e.g. chronic obstructive pulmonary disease, bronchial asthma, emphysema), pathognomonic findings could be extracted from radiography of the chest of the patients and/or when the patient was preoperatively medicated with bronchodilatory medication. PPCs developed in 21.9% (24.4%) of patients with nicotine (alcohol) abuse but only in 15.8% (14.5%) of patients without nicotine (alcohol) abuse ($P = 0.046$, OR = 1.50 for nicotine abuse; $P = 0.002$, OR = 1.90 for alcohol abuse). Patients