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Influence of smoking status at time of surgery for herniated lumbar disk on postoperative pain and health-related quality of life

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ABSTRACT

Background: It is well established that smoking has a myriad of negative effects on varies aspects of bodily health. The aim of this study was to examine the effects of the smoking status at time of surgery on the postoperative subjective pain course and health related quality of life (HRQoL) until 1 year after surgery for lumbar disc herniation (LDH).
Method: This prospective cohort study included patients ≥18 and ≤90 years of age with a symptomatic and radiological verified LDH. The current smoking patient collective (smoking 1 or more cigarettes a day) was compared with the nonsmoking collective (previous smokers without cigarette consumption for >2 months and never smokers) in respect of subjective pain sensation (measured with the visual analogue scale (VAS)) and HRQoL using the short-form (SF-12) questionnaire preoperatively, before discharge, as well as after 4 weeks and 1 year postoperatively. The primary outcome measures were the 1-year SF-12 scores (MCS and PCS) categorized into responders and non-responders.
Results: A total of 102 patients were enrolled in the study. Thirty-eight patients were current smokers (37.2%), whereas 43 (42.2%) and 21 (20.6%) patients were never-smokers and previous smokers, respectively. Four weeks and one year after surgery, both smokers and nonsmokers reported increase in the HRQoL as compared to preoperative values – the MCS increased more than the PCS. From a univariate and multivariate perspective, smoking status at time of surgery did not predict responder status.
Conclusions: The present study results could not confirm the hypothesis that smoking at time of surgery was associated with worse outcome after surgery for LDH.

1. Introduction

Smoking is known to be associated not only with many chronic diseases, but also with substantial burdens on healthcare systems worldwide [1]. Furthermore, it is well established that smoking has a negative effect on postoperative outcome for patients undergoing surgical procedures including a higher likelihood of 30 day mortality and serious postoperative complications [1,2]. Smokers are also at greater risk of postoperative wound healing disturbances compared to nonsmokers [3]. This information is of paramount importance for the patient information and informed consent prior to elective surgery, as there is evidence that perioperative smoking cessation may reduce peri- and postoperative complications [4,5]. Therefore, the patient has to be informed about the negative effect of smoking in the peri- and postoperative phase and about a possible advantageously effect of smoking cessation. The subsequent benefit of smoking cessation may not only be apparent in the immediate postoperative recovery but also in the long-term convalescence [6].

Although there is growing amount of literature across many surgical specialties (e.g. in the area of breast surgery, orthopedic and reconstructive surgery, obstetric surgery, general surgery, cardiac surgery, head and neck surgery, lung cancer surgery) regarding the effects of smoking on short- and long-term complications, cancerogenity, respiratory and cardiovascular morbidity, reduced health-related quality of life (HRQoL), and premature death on a increasing number of diseases, there is dearth of literature on the effect of smoking on the postoperative pain course and HRQoL in lumbar spine surgery. Still, it has been demonstrated that spinal fusion rates are significantly worse in

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smokers with nonunion occurring in 40% of cases and 5 times more often than in nonsmokers (8%) [7]. Interestingly, an improved spinal fusion rate could be achieved by preoperative nicotine and smoking cessation in an animal model [8]. Clinical data indicates that even postoperative smoking cessation leads to better fusion rates in patients after fusion surgery [9].

According to the above-mentioned literature and our clinical observation we intended to test the hypothesis that smoking patients experience more peri- and postoperative complications, suffer more pain and improve less until one year after surgery for lumbar disc herniation (LDH).

2. Methods and materials

The study was conducted as a prospective cohort study, including patients with a symptomatic and radiological verified LDH. Patients eligible for the study were $\geq$18 and $\leq$90 years of age and were operated between October 2010 and February 2011 in our department. Study exclusion criteria were preoperative systemic sepsis, disseminated cancer disease, open wound infection before surgery, or known bleeding disorders. Institutional review board approval was obtained from the local ethics committee. After written informed consent, all patients received a specially designed baseline questionnaire concerning demographic and social case history, education and profession information, diagnosis and bodily restrictions, detailed pain data, cardiovascular risk factors, and detailed smoking habits. Before hospital discharge, all patients filled out a second questionnaire containing diagnosis and bodily restrictions as well as a detailed pain data sheet. A third and fourth questionnaire concerning social data, current profession, diagnosis and bodily restrictions, detailed pain data, cardiovascular risk factors, and a detailed smoking evaluation was mailed to all patients 4 weeks and 1 year postoperatively, respectively. The subjective pain sensation was estimated via a standardized questionnaire containing the visual analogue scale (VAS). The HRQoL was assessed by the German version of the 12-item short-form health survey (SF-12) questionnaire [10]. The perioperative complication rate was evaluated by analyzing the incidence of incidental durotomies, wound infections, and need for re-operation as well as by the estimated blood loss (EBL) during surgery, the operation time and the length of overall hospitalization time.

2.1. Study groups

Current smokers were defined as smokers who were smoking one or more cigarettes a day. Previous smokers were defined as persons who did not smoke for at least 2 months prior to the neurosurgical intervention. Finally, never smokers were defined as those who never smoked in the previous year and reported 0 lifetime pack-years (PY). For the analysis, previous smokers and patients who never smoked were combined and compared with the smoking patients at the time of the hospitalization. The choice of grouping non-smokers and previous smokers was based on previous studies use of smoking status at surgery [9,11–22]. In addition, this grouping was preferred because of the finding in other studies that smoking status at surgery was better at predicting outcomes than cumulative smoking status [9,12].

2.2. Statistical methods

Balance in baseline and radiographic variables was evaluated using Fisher's exact tests for categorical variables. The presence of missing data necessitated the use of multiple imputation to complete the dataset in order to assess influence of the missing values on standard errors. After the results were imputed (see next section) the baseline mental component scores (MCS) and physical component scores (PCS) were subtracted from the patient's respective 1-year MCS and PCS score. The results were categorized into the previously validated five-tier categories for LBP (much better, better, little better, same, a little worse and worse) according to Luo et al., [23] and then turned into a binary responder and non-responder variable. Responders were defined as patients feeling much better, better and a little better. In contrast, non-respondence was determined as no change or worsening compared to preoperatively. Primary outcome therefore was defined SF-12 scores at 1-year postoperatively categorized into responders and non-responders. From here, multivariable logistic regression models were built to assess the relationship of smoking to outcomes in the presence of potential confounders. For this, a univariate perspective and a multivariate model was used with full entry methods of model building [24]. Results were presented in standard regression tables with additional estimates of the percentage change of standard errors due to the missing data. The software used for the statistical analysis was Stata v11.2 (College Station, Texas).

2.3. Multiple imputation

Multiple imputation was used to handle the missing data load of 34% at 1-year follow-up. Essentially, multiple imputation allows us to maintain the integrity of the cohort by viewing missing values as a source of variability to be averaged over, rather than just omitting data, and therefore effectively ruining the cohort. Multiple imputation requires three steps. The first step estimates the values for the missing data using regression methods (a model which includes random variation) on the basis of all the present information in the dataset, which allows easy reproducibility. The dataset is reproduced m times, so that there are $m+1$ datasets. From here, a standard complete-data model is created (in this case a logistic regression model), and run on each imputation including the original ($m+1$ times). Then, the estimates are combined to present within imputation variance and between imputation variance (standard error) estimates. It is this part of multiple imputation which is perhaps the most valuable to the read. Within imputation, variance represents the standard variation, and the between variance estimates the added variance which is due to the missing values. This assumes that the data are missing at random, which means amongst other things that the variable with missing data itself cannot predict the probability of the data being missing. In other words, 1-year SF-12 scores (variable with missing data in this dataset) cannot predict the probability of these values being missing. We imputed 4 variables (Y): namely the SF-12 PCS as well as the SF-12 MCS at 1-year postoperatively, as well as the changes in these scores when compared to baseline (PCS/MCS 1-year postoperatively minus PCS/MCS at baseline). The number of imputations (m) was set at 35.

3. Results

3.1. Baseline demographics and neurological status

A total of 112 patients were screened between October 2010 and February 2011; six refused consent. Four patients had to be excluded because their health status increased under conservative therapy and surgery was therefore not performed. After considering exclusion criteria, a total of 102 patients were enrolled in the study, with all 102 patients undergoing surgery for LDH. Thirty-eight patients were current smokers (37.2%), whereas 43 (42.2%) and 21 (20.6%) patients were never-smokers and previous smokers, respectively. Baseline demographic data and the preoperative status are depicted in Table 1. Besides a higher prevalence of