Prevalence and predictors of postoperative pain in (ENT) patients

ORIGINAL ARTICLE

Prevalence and Predictors of Postoperative Pain After Ear, Nose, and Throat Surgery

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Objective: To determine postoperative pain in different types of ear, nose, and throat (ENT) surgery and their psychological preoperative predictors.

Design: Prospective cohort study.

Setting: Academic hospital.

Patients: A total of 217 patients undergoing ENT surgery.

Interventions: All ENT, neck, and salivary gland surgery.

Main Outcome Measures: Postoperative pain and predictors for postoperative pain.

Results: Fifty percent of the patients undergoing surgery on the oral, pharyngeal, and laryngeal region and on the neck and salivary gland region had a visual analog scale score higher than 40 mm on day 1. In the patients who underwent oropharyngeal region operations the VAS score remained high on all 4 days. A VAS pain score higher than 40 mm was found in less than 30% of patients after endoscopic procedures and less than 20% after ear and nose surgery. After bivariate analysis, 6 variables–age, sex, preoperative pain, expected pain, short-term fear, and pain catastrophizing–had a predictive value. Multivariate analysis showed only preoperative pain, pain catastrophizing, and anatomical site of operation as independent predictors.

Conclusions: Differences exist in the prevalence of unacceptable postoperative pain between ENT operations performed on different anatomical sites. A limited set of variables can be used to predict the occurrence of unacceptable postoperative pain after ENT surgery.

Arch Otolaryngol Head Neck Surg. 2009;135(2):124-130

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ADEQUATE POSTOPERATIVE pain management is an essential part of perioperative care because postoperative pain results in patient discomfort and may decrease patient satisfaction.[1] More important, it may increase the risk for pulmonary and cardiovascular complications and may even contribute to the development of chronic pain.[2-4] Although in the last few decades a vast range of new therapeutic developments have occurred (eg, in new formulations of pain medication), postoperative pain remains a persistent problem.[5,6] To improve postoperative pain control, it would be desirable to preoperatively distinguish patients and patient groups who are at risk of developing unacceptably high levels of postoperative pain. The type of surgery is a factor that determines the level of postoperative pain.[7] However, with the exception of pain after tonsillectomy, a common and very painful procedure, surprisingly little literature is available on the amount of postoperative pain after ear, nose, and throat (ENT) surgery.[8,9] Rates of absence from work for more than 2 weeks following routine ENT surgery and rates of readmission or overstay after day-case (outpatient) nasal surgery that are higher than 10% suggest that this patient group cannot be neglected and that the pain levels experienced by patients who have undergone ENT surgery is probably highly underestimated.[10,11]

The type of surgery is not the only determinant of postoperative pain because patients undergoing the same procedure may require plasma levels of opiates varying more than 5-fold to provide satisfying analgesia. Other determinants (determined in groups that consisted of all types of surgery) that have been suggested to predict postoperative pain are female sex, younger age, the amount of preoperative

pain, and psychological factors including preoperative anxiety and catastrophizing.[12-17]

The purpose of this study was to objectify postoperative pain in different types of ENT surgery, using a visual analog scale (VAS), and to identify somatic and psychological preoperative predictors for unacceptable high levels of pain in this patient group. A mean pain score of higher than 40 mm on a VAS is generally regarded as being unacceptable.[18-20] Patients undergoing ENT surgical procedures participated in this study, which consisted of preoperative assessments of somatic and psychological variables and daily assessment of pain until postoperative day (POD) 4.

METHODS

DESIGN

This study is a secondary analysis of data from 2 prevalence studies[21,22] with a longitudinal design that were performed to obtain short-term follow-up data on surgery-related pain on the day of surgery (POD 0) and PODs 1 to 4.[23] In the 2 surveys, data were obtained from 2138 consecutive patients; 304 of them had been admitted for ENT surgery (hereinafter, ENT patients). The final study sample comprised 217 ENT patients. From these 217 subjects, 181 were admitted to a surgical ward and 36 to a day-case unit.

SUBJECTS

This study was performed in a general university teaching hospital with 715 beds; 183 of the beds are located on surgical wards. The institutional ethics committee approved the survey.

All patients aged 18 to 80 years scheduled for ENT surgery were approached for possible study participation from October 2002 through September 2003. From October 2002 through January 2003, the patients scheduled for ENT surgery in a same-day admission unit were approached, and from January 2003 though September 2003, ENT surgery inpatients were enrolled. Each subject was evaluated for eligibility to participate in the study (age > 18 years, no limitations of self-expression, no visual dysfunction or language problems). Patients admitted for acute surgery or requiring postoperative ventilatory support were excluded from the study. Also excluded were 82 patients, including 36 who did not meet inclusion criteria, 17 who refused to participate (less than 1%), and 29 who did not participate for other reasons. The characteristics of the patients who refused to participate were no different in demographics and type of operation from those of the participants. Data on a total of 217 patients were studied.

OUTCOME AND CANDIDATE PREDICTORS

The outcome of the present study was the presence of unacceptable postoperative pain, defined as a mean VAS pain score of 40 mm or higher[18-20] (the mean of 3 scores on POD 0 and PODS 1-4).

Fourteen candidate predictors of unacceptable postoperative pain were selected. These included somatic variables (type of operation, age, sex, duration of surgery, American Society of Anesthesiology [ASA] score, preoperative pain, and type of admission) and psychological variables (expected pain, surgical fear, catastrophizing, and optimism). The ASA score describes the patient from the perspective of basic risk banding. Research into perioperative outcome uses these scores widely as descriptors of the surgical population

INSTRUMENTS AND PROCEDURES AND PREOPERATIVE ASSESSMENT

The data collection instruments consisted of preoperative questionnaires and a postoperative pain and medication diary. Eligible patients received a letter describing the purpose and methods of the study and a set of questionnaires 1 to 3 weeks before treatment. The following questionnaires were included: (1) the pain catastrophizing scale (PCS) (13 items), which measures an exaggerated negative attitude toward pain, and (2) the Life Orientation Test (8 items), which measures dispositional optimism.[14,16] Completion of questionnaires took 7 to 10 minutes. Patients were requested to bring the completed questionnaires to the hospital on the day of admission.

After admission to the surgical ward or day-case unit, a trained research assistant explained the purpose and methods of the study to each eligible patient who was willing to participate. Sociodemographic variables such as date of birth, sex, and education were recorded, and a questionnaire on surgical fear was filled out. This 10-item questionnaire on surgical fear was adapted from Koivula et al.[24] For the present study, only the subscale "fear of immediate consequences" (4 items, Cronbach α, 0.83: anesthetics, 0.90; operation, 0.84; unpleasant adverse effects, 0.7; pain, 0.66) was used.[16] Furthermore, pain intensities at rest and while coughing and expected pain after the operation were scored, using a 100-mm VAS anchored to "no pain" and "the worst pain I can imagine."

POSTOPERATIVE PAIN ASSESSMENT

Pain intensity at rest and while coughing was scored at 1 and 3 hours after surgery. For day-case surgery, scoring took place at 1 hour after surgery and at the time of discharge. On PODs 0 to 4, pain was scored in a pain diary 3 times a day. All the inpatients who underwent surgery on the respective day were visited by trained research assistants at 9 PM. Furthermore, research assistants visited all the inpatients at least once a day to give help if necessary.

Day-case patients and patients from the surgical ward who were discharged from the hospital within 4 days after surgery took their pain and medication diary home and returned it to the research team in a special prepaid envelope. If diaries had not been returned within 14 days after surgery, we followed up by contacting the patient by telephone.

PAIN MANAGEMENT

The perioperative pain protocol that has been used at this hospital since 1995 is based on the stepwise approach of acute pain treatment described by Rawal.[25] All the operations are categorized into 3 groups (minor, intermediate, and major surgery) based on the anticipated level of postoperative pain. Subsequently, all the surgical procedures were categorized according to the anatomical site. The ENT surgical patients were categorized in the minor and intermediate surgical groups. Procedures involving the ear and nose and endoscopies were mainly categorized as the minor procedure group, and procedures involving the oral cavity, pharynx, larynx, neck, and salivary glands were categorized in the intermediate procedure group (**Table 1**).

In agreement with the prevailing protocol, all patients received acetaminophen orally or rectally 1 hour before induction of anesthesia. After minor operations, the patients were treated with paracetamol, 1000 mg, 4 times a day combined

Table 1. Ear, Nose, and Throat Operations According to Anatomical Region

Anatomical Region (No. of Procedures)	Type of Operation
Ear (n=54)	
Outer ear (n=8)	Incision; drainage of ear canal, drainage retroauricular abscess, partial excision auricle, first-phase BAHA, mastoid screw, reconstruction with transplantation
Middle ear (n=46)	Transmeatal drainage and ventilation tubes, inspection; diagnostic, radical mastoidectomy, cleaning of the middle ear and nose, stapedectomy or stapedotomy, tympanoplasty type II, tympanoplasty type I, tympanoplasty type I and OCR. Chain reconstruction, tympanoplasty, facial nerve decompression, cochlear implantation, excision of glomus tumor
Nose (n=51)	
Nasal cavity, n=14)	Extraction nasal polyps; infundibulum,1-sided; extraction of nasal polyps; infundibulum, 2-sided; polypectomy, 1-sided; conchotomy, 1-sided; concha cauterization, 1-sided, biopsy, 1-sided; concha luxation
Paranasal sinuses (n=15)	Endonasal ethmoidectomy; external ethmoidectomy, 1-sided; ethmoid operation, nose; sphenoidal exploration, 1-sided; combined operations, Moure, Caldwell-Luc, endonasal excision tumor, lateral rhinotomy
External nose and nasal skeleton (n=22)	Correction of cartilaginous pyramid nose; septal perforation closure; open rhinoplasty; nasal septum correction; left lateral osteotomy, total resection; excision of tumor, cyst, or fistula
Throat (n=22)	
Oral cavity (n=4)	Partial glossectomy, excision of malignant tumor of mouth floor
Pharynx (n=16)	Adenotomy or adenoidectomy, tonsillectomy, laser excision tumor hypopharynx, excision tumor
Larynx (n=2)	Reduction stenosis or webs, insertion voice prosthesis
Neck and salivary glands (n=28)	
Neck (n=15)	Radical neck dissection, myotomy cricopharyngeal muscle, excision branchial cyst, total laryngectomy
Salivary glands (n=13)	Total parotidectomy, lateral parotidectomy, excision of other salivary glands, partial parotidectomy, extirpation of the submandibular gland
Endoscopy (n=62)	Pharyngoscopy (diagnostic), esophagoscopy (diagnostic), transoral nasopharyngoscopy (diagnostic), microlaryngoscopy (therapeutic), direct laryngoscopy (therapeutic), direct laryngoscopy (diagnostic), microlaryngoscopy (diagnostic), endoscopic treatment of Zenker diverticulum, esophagus (dilation)

Abbreviations: BAHA, bone-anchored hearing aid; OCR, ossicular chain reconstruction; UPPP, uvulopharyngopalatoplasty.

with nonsteroidal anti-inflammatory drugs administered by the ward nurses. Rescue medicine for moderate or severe pain (VAS>40 mm) was piritramide given intramuscularly.

Pain after intermediate operations was treated using the same protocol combined with intravenous piritramide, 2 to 5 mg, which was repeated until the patient reported being pain free. This was followed by intramuscular piritramide, 10 to 15 mg, 6 times a day. All ENT operations were conducted under general anesthesia.

STATISTICAL ANALYSES

Actual pain scores (VAS, 0-100 mm) were used on the day before the operation. Mean pain scores were calculated from each individual, measured on PODs 0 to 4, using the mean of the 3 scores obtained on each of the days. Because the pain diaries were sometimes incomplete, totals could vary from day to day. A mean VAS pain score higher than 40 mm was regarded as being unacceptable.[18-20]

To determine which variables independently predict the risk of a postoperative VAS of 40 mm or higher on PODs 0 to 4, we first estimated the association between region of operation and endoscopies with each candidate predictor and the outcome (bivariate analysis). The operation regions and endoscopies, specified in Table 1, were considered very important for prediction of unacceptable pain and therefore remained in the model. All preselected candidate predictors with a $P<.15$ were considered in the multivariable analysis using logistic regression modeling.

Missing values in predictor variables were imputed. This was performed because of a presumed nonresponse problem in which the occurrence of missing data is related to the outcome value. Patients who did not fill in all data may have had severe pain at that point in time or, in contrast, no pain at all. Either way, this could influence the outcome. Missing predictor values were imputed according to the multiple imputation (MI) method described by Rubin and Schenker[26] and van Buuren et al.[27] Assuming a missing at-random mechanism, each missing value can be imputed using a regression model with the other covariates and outcome as predictor. The imputation is a stochastic process because the value is drawn from a density function generated by the regression model. In this way, a complete data set is generated, and this process is repeated at least twice. For the present study, the imputation procedure was performed 5 times, obtaining 5 complete datasets, with imputed values for expected pain (n=4 [1.6%]), surgical fear (n=6 [2.8%]), pain catastrophizing (n=8 [3.7%]), and optimism (n=10 [4.6%]). For each of the 5 datasets that were obtained after MI, multiple logistic regression analysis was performed to identify the factors that independently predicted the risk of having unacceptable postoperative pain (VAS≥40 mm) on POD 0 and PODs 1 to 4. Missing values in outcome measures (pain scores) were not imputed. However, these missing data could be subject to selection processes as well. Therefore, logistic regression analyses were used to investigate whether these missing outcomes could be predicted with available covariates (ASA grade, preoperative pain, sex, etc). The results revealed some significant relationships and were used to calculate a P value weight factor for each case.

For the multivariable logistic model, the continuous quality of the psychological variables was retained. Using a forward entry procedure, the criterion for adding a variable was $P>.05$ based on the log-likelihood ratio test. A variable was included in the final analyses when the variable appeared at least 3 times in the 5 imputation sets. The model's ability to dis-

Table 2. Baseline Characteristics

Characteristic	Subjects, No. (%)
Total	217
Sex, No.	
Male	129 (59.4)
Female	88 (40.6)
Age, y	
18-39	65 (30)
40-59	86 (39.6)
>60	66 (30.4)
Educational level[b]	179 (83.0)
Elementary	58 (26.7)
High school	59 (27.2)
College and university	62 (28.6)
Preoperative VAS > 40 mm	14 (6.5)
Type of admission	
Inpatient	181 (83)
Outpatient	36 (17)
ASA score	
1	105 (48)
2	80 (37)
3	30 (14)
4	2 (1)
Surgery time, min	
<60	126 (58.0)
60-180	77 (35.5)
>180	14 (6.5)
Expected VAS > 40 mm	85 (39)

Abbreviations: ASA, American Society of Anesthesiology; VAS, visual analog scale.
[a]The mean (SD) age was 16 (50) years, with 152 patients (70%) older than 40 years.
[b]Data were not available for 17% of the subjects.

criminate between patients with and without unacceptable postoperative pain was estimated by the area under the receiver operant curve. Statistical analyses were performed with Stata software (version 8; StataCorp, Cary, North Carolina) and SPSS software (version 12; SPSS Inc, Chicago, Illinois).

RESULTS

Baseline characteristics are presented in **Table 2**. More male patients (59.4%) were included than female (40.6%). The **Figure** indicates the distribution of mean pain scores on the day before surgery until POD 4 at rest and while coughing. The ENT operations performed in the region of the mouth, throat, neck, and salivary glands were painful (VAS score ≥ 40 mm) on POD 0. Approximately 48% of the patients in these groups had unacceptable pain at rest, and 58% had a mean VAS score greater than 40 mm while coughing on POD 0 (Figure). For mouth and throat surgery, this condition persisted almost throughout the whole study period.

Of the initial 10 predictors other than operation region and endoscopies, only 6 remained after bivariate analysis (ie, age, sex, preoperative pain, expected pain, surgical fear, and pain catastrophizing). The multivariable regression analysis with these 6 predictors and the anatomical site of the intervention yielded a receiver operating characteristic curve area of 0.76 to 0.72 for POD 0 until POD 4 (**Table 3**). Predictors that seemed

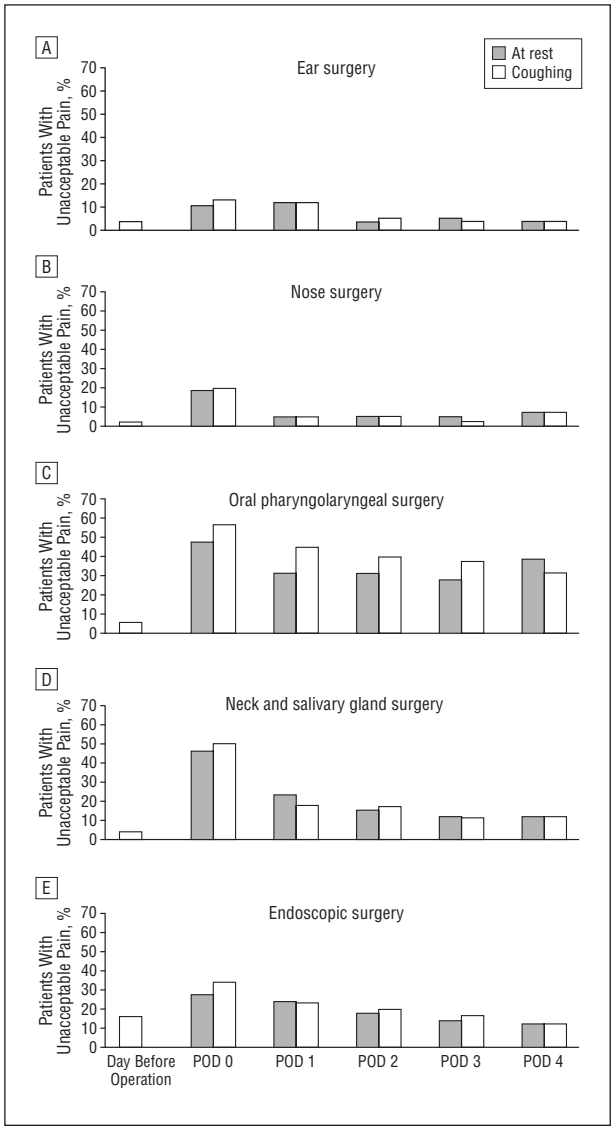

Figure. Percentages of patients with a visual analog scale (VAS) for pain of 40 mm or higher at rest on the day before operation and mean VAS score of at least 40 mm at rest and while coughing on postoperative days (PODs) 0 to 4 after various types of ear, nose, and throat surgery grouped by anatomical site.

relevant for the model (eg, sex, age, and surgical fear) were not independent predictors in multivariate analysis. Apparently, the retained predictors already provided for their predictive information. Anatomical site (ie, oral cavity, pharynx, larynx, neck salivary glands, and, on POD 2, also including endoscopic procedures), preoperative pain on POD 1, and pain catastrophizing on PODs 2 to 4 remained in the model as predictors of significant higher risk of unacceptable pain. Multivariate analysis indicates that the risk of pain is 4 to 10 times higher in the oral cavity, pharynx, larynx, and neck salivary gland surgery category compared with the ear surgery category (Table 3). Pain catastrophizing is measured on a scale of 0 to 52. When comparing 2 groups, the interpretation of the odds ratio (OR) of the pain catastrophizing score is dependent on the difference of this score between these groups; for example, an increase of 10 points in the PCS scale would mean an

Table 3. Results of the Logistic Regression Analyses for Postoperative VAS Pain Score Greater Than 40 mm (on a 100-mm Scale) on the Day of the Surgical Procedure (SP) and on Postoperative Days (PODs) 1 to 4[a]

Independent Variable, No.	Day of SP (n=188) (Area Under ROC Curve, 0.76)	POD 1 (n=212) (Area Under ROC Curve, 0.69)	POD 2 (n=212) (Area Under ROC Curve, 0.76)	POD 3 (n=214) (Area Under ROC Curve, 0.70)	POD 4 (n=209) (Area Under ROC Curve, 0.72)
Anatomical site					
Ear; outer/middle	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Nasal cavity; paranasal sinuses; external nose and nasal skeleton	1.4 (0.4-4.5)	0.9 (0.2-4.5)	1.5 (0.2-10.4)	2.5 (0.5 to >15)	1.9 (0.3 to 11.7)
Oral cavity; pharynx; larynx	4.7 (1.4-16.3)[b]	3.8 (1.1-13.1)[a]	8.3 (1.4-48.0)[b]	14.1 (0.1 to >50)	10.1 (1.8 to 58.4)[b]
Neck; salivary glands	5.7 (1.5-21.0)[b]	1.6 (0.4-6.3)	7.5 (1.3-43)[b]	10.6 (0.2 to >50)	3.2 (0.5 to 19.3)
Endoscopy	1.7 (0.5-5.1)	2.1 (0.6-7.4)	7.6 (1.4-41)[b]	6.7 (0.4 to >50.0)	2.1 (0.4 to 12.6)
Sex: female vs male	0.9 (0.7-1.2)	NE	NE	NE	NE
Age per 10 y	0.8 (0.6-1)	NE	NE	NE	NE
Preoperative pain					
VAS score per 10 mm	1.4 (0.9-2.0)	1.3 (1.02-1.7)[b]	NE	NE	NE
Expected pain					
VAS score per 10 mm	1.2 (0.9-1.4)	NE	NE	NE	NE
Short-term fear per unit	NE				
Pain catastrophizing per unit	NE	1.05 (>0.9-1.1)	1.05 (1.01-1.1)[b]	2.8 (2.7-3.0)[b]	1.04 (>1.0-1.1)[b]

Abbreviations: NE, variable not in the equation; ROC, receiver operating characteristic.
[a] Data are presented as odds ratios (95% confidence intervals).
[b] Significantly higher risk of unacceptable pain.

OR or risk increase on POD 4 of 1.57 (this equals the coefficient 1.046 in Table 3 to the power of 100).

COMMENT

The data from this study demonstrate that there are remarkable differences in postoperative pain sensations at the different anatomical sites of ENT surgery. A large group of patients have an unacceptable level of pain after surgery on the oral region, pharynx, larynx, neck, and salivary glands. Multivariate analysis indicates that the risk of pain is 4 to 10 times higher in these groups compared with those in the ear surgery category. The anatomical site seems to play an important role as a predictor of postoperative pain after ENT surgery.

A problem in this study was missing data on predictor variables (4%) and the outcome variable pain (day before surgery, 1.6%; for PODs 1-4 the mean was 9.6%). However, for the missing predictors an MI method was used as suggested by Rubin and Schenker[26] and van Buuren et al.[27] We adjusted for the missing outcome by using *P* value weights as suggested by Rubin and Schenker.[26] Because the percentage of missing data is low and the imputation method only marginally attributed to the total variance, it was assumed that the missing data hardly affected the results.

Preoperative experimental pain stimuli, such as cold pressure test, electrical skin stimulation, or heat stimuli, were not assessed in an attempt to predict postoperative pain. Recent data indicate that the response to these stimuli could predict the level of postoperative pain.[12,28-32] It would be interesting to measure the predicting power of these tests in relation to the other possible predictors. However, we feel that the value of these tests is very limited in a clinical setting. In contrast, the use of the PCS and the VAS scale (to measure preoperative pain) in an attempt to predict postoperative pain is very feasible in this study hospital because every patient has to be screened preoperatively at the preassessment polyclinic.

In the intermediate procedure group, pain remained at a high level during the 4 days of follow-up of this study (OR, 3.8-10). A possible explanation for these high scores is that 9 of 22 patients underwent adult tonsillectomy and had a VAS score higher than 40 mm. This is similar to findings in the literature, which show that the pain level after adult tonsillectomy stays high until the seventh day, after which it slowly declines.[19,33,34] Conforming to the literature, a low level of pain in the minor surgery group was found in this study.[35] Multivariate analysis shows preoperative pain as an independent predictor on POD 0 and on POD 1. Other studies[13,21] confirm the value of preoperative pain as an independent predictor.

In previous studies,[17,29,36] expectation of postoperative pain and state of anxiety turned out to be independent predictors. In this study, high expectation of pain and degree of anxiety are not independent predictors. A possible explanation for these conflicting data is that the previous studies did not assess pain catastrophizing. Pain catastrophizing has been defined as an exaggerated negative orientation to aversive stimuli that involves rumination about painful sensations, magnification of the threat value of the pain stimulus, and perceived inability to control pain. It is very likely that, if these studies also had corrected for catastrophizing, expectation of pain and degree of anxiety would no longer have been independent factors or their predictive value would have been substantially reduced. Catastrophizing has been shown to be associated with emotional distress states such as anxiety and depression, and expectation of high levels of postoperative pain seems to be the result of catastrophizing.[14,20,37-39]

Catastrophizing is a good predictor of postoperative pain.[14,30,38] Patients with high catastrophizing scores are at risk to experience pain longer after surgery. It is quite

possible that these patients experience pain longer because of their heightened attention to the painful stimulus. The limitations of these earlier studies,[14,30,38] which investigated the predictive properties of catastrophizing, are the rather small sample sizes (38, 47, and 48 patients, respectively) and the lack of evaluation of the whole range of other determinants that have been imputed predictive values in the literature. In contrast, this study was built on a relatively large sample size and proves the superiority of catastrophizing in regard to other psychological determinants.

The data of the present study demonstrate that there are large differences in levels of postoperative pain after ENT surgery if the anatomical site is considered. Although some large studies[13,22,40] measured the amount of pain in different surgical categories, like abdominal or orthopedic surgery, this study shows that this categorization is probably not sufficient because major differences in pain sensation manifest themselves within ENT surgery.

Many endoscopic procedures are considered to be relatively painless and, at worst, associated with mild discomfort. This study seems to prove otherwise. Compared with nose surgery on POD 3 there is an OR, or risk increase, of unacceptable pain occurring of 7.6. As yet, there is no explanation for this phenomenon.

The presence or absence of unacceptable levels of postoperative pain after general anesthesia in patients undergoing ENT surgery can be predicted with a limited amount of variables (ie, operation region, preoperative pain, and pain catastrophizing). Because preoperative use of PCS and the VAS for pain in an attempt to predict postoperative pain is considered feasible in current clinical practice, given that every patient should be screened preoperatively, these findings can be helpful in improving postoperative pain treatment.

How the catastrophizing postoperative patient should best be treated, with pain medication or otherwise, remains an unanswered question and could be a topic for future research. The results of this study will assist in improving postoperative pain treatment and in tailoring individual pain management.

Submitted for Publication: October 24, 2007; final revision received April 8, 2008; accepted April 24, 2008.
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Author Contributions: All authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Kessels, Peters, Patijn, van Kleef, and Marcus. *Acquisition of data:* Geurts, Kessels, Peters, van Kleef, Kremer, and Marcus. *Analysis and interpretation of data:* Sommer, Geurts, Stessel, Kessels, Peters, and Marcus. *Drafting of the manuscript:* Sommer, Geurts, Stessel, Peters, Patijn, van Kleef, and Marcus. *Critical revision of the manuscript for important intellectual content:* Sommer, Geurts, Kessels, Peters, Kremer, and Marcus. *Statistical analysis:* Geurts, Kessels, Peters, and Marcus. *Obtained funding:* Geurts, Patijn, van Kleef, and Marcus. *Administrative, technical, and material support:* Sommer, Geurts, Stessel, Patijn, van Kleef, and Marcus. *Study supervision:* Geurts, Peters, Patijn, van Kleef, and Marcus.
Financial Disclosure: None reported.
Funding/Support: This study was supported by the Pain Management and Research Center, subsidized by the Ministry of Health, the Netherlands.

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