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Attentional Avoidance of Negative Experiences as Predictor of Postoperative Pain Ratings and Consumption of Analgesics: Comparison with Other Psychological Predictors

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Abstract

Objective. Attentional avoidance of negative stimuli and preference for positive stimuli (assessed prior to surgery) have been found to be predictive of postoperative pain. However, findings so far were mainly obtained in young patients with benign diagnoses. The aim of the present study was to test whether this relationship holds for aged patients with poorer prognosis.

Design. Preoperatively assessed psychological predictors, including attentional measures for emotionally loaded stimuli, among others, were used to predict acute postoperative pain as indicated by rating and consumption of analgesics.

Patients. Fifty-eight patients scheduled for surgery due to cancer (80%) with a mean age of 60.5 years participated in the study.

Outcome Measures. As predictors attentional biases for pain-related, social threat, and positive stimuli were assessed in a dot-probe task. Further predictors were self-reported pain vigilance, pain anxiety, pain catastrophizing, general anxiety, depression, and somatization, as well as pressure pain thresholds. As criteria of prediction, numerical scale ratings of acute postoperative pain and the amount of analgesics (patient-controlled intravenous analgesia [PCIA]) requested after surgery were used.

Results. Only the dot-probe task parameters provided significant explanation of acute postoperative pain. A significant 23% of variance of the PCIA use was accounted for by the dot-probe task parameters. Here, it was mainly the avoidance of social threat words which contributed to significant prediction and did not appear to be related to the other psychological predictors. Seventy-seven percent of the patients with frequent PCIA use could be classified correctly by this variable.

Conclusions. Attentional avoidance of emotionally negative stimuli prior to surgery proved to be a powerful predictor of acute postoperative pain reflected by the consumption of analgesics; this time in a sample of aged patients with various but mainly malign diagnoses. This measure outperformed traditional predictors like depression, anxiety, as well as pain catastrophizing, and deserves further attention.

Key Words. Attention; Postoperative Pain; Psychological Predictor

Introduction

Postoperative pain, in its acute form, is an unavoidable aspect of surgery, which requires intensive analgesic treatment. Although management of acute postoperative pain has become largely efficient, outcome is still variable between patients. In face of similar tissue lesions, some patients report high levels of acute pain despite reasonable dosage of analgesics whereas other patients do not [1]. Better prediction of the short-term course of postoperative pain would not only allow for more efficient management of postoperative pain but would also enrich our understanding of the multiple factors involved in pain genesis. Alongside somatic factors, psychological factors have also been shown to contribute significantly to postoperative pain [2,3]. When reviewing those psychological factors that have been examined so far, it becomes apparent that major emphasis has been placed on measures that are based on self-awareness and self-report. For example, self-rated depression, anxiety, neuroticism, and pain catastrophizing have commonly been studied [2,3].

However, research on "hypervigilance," which has been named a critical candidate as regards the explanation of development of chronic pain [4], has let to a recent change in the research focus by also considering implicit information processing beyond the conscious accessibility to self-report. Hypervigilance is defined as the repetitive and automatic attentional prioritization of pain, with the original function of escape and avoidance from physical threat but with maladaptive consequences on the long run. Attention tests like the visual dot-probe task [5] and the emotional Stroop paradigm [6] have been developed to assess these implicit and unconscious attentional processes. These tests also allow for the assessment of the opposite of hypervigilance, namely attentional avoidance, which may occur when pain- or threat-related stimuli are feared and, by that, already unconsciously avoided.

In two studies of the authors, dot-probe task parameters have appeared to be significant predictors of acute and chronic forms of postoperative pain [7,8], once in the form of attentional avoidance of pain-related stimuli and once in the form of attentional preference for positive stimuli. Accordingly, the common denominator in both previous studies (investigating young male subjects undergoing cosmetic surgery) was an attentional bias away from emotionally negative stimuli toward positive stimuli, which significantly predicted postoperative pain. Such a relationship has also been found by other research groups. For example, Munafò and Stevenson [9], who were the first to predict postoperative pain due to minor gynecological surgical procedures by a selective processing task (modified Stroop test) using an implicit measure of attention, reported similar findings.

Now, it seems necessary to expand the data basis as replication and to include patients with different forms of surgery as well as with different somatic and psychological conditions. Therefore, a major aim of the present study was to assess attentional biases related to emotionally negative and positive stimuli in aged patients with indications for surgery due to malign diagnoses. We hoped to prove the predictive power of our dot-probe task parameters for acute postoperative pain alone and in comparison with psychological predictors, namely self-reported pain catastrophizing, pain vigilance, pain anxiety, general anxiety, depression, and somatization parameters, which have been used in the past with some success [2,3]. In addition, pressure pain threshold was entered into our predictor analysis. We tested the predictive value of these variables for prognosis of acute postoperative pain (first hours to days after surgery) reflected by numerical pain ratings and the use of patient-controlled analgesia (PCA). With PCA analgesimetry, the analgesic demand is the measure of pain, which is an indirect but clinically relevant approach [10].

Materials and Methods

Subjects

Fifty-eight patients (10 women, 48 men) with a mean age of 60.5 years (standard deviation = 9.4 years) participated in the present study. Subjects were recruited among inpatients of the Hospital am Bruderwald (Bamberg, Germany) and were presented with mixed indications for surgery (see Table 1) with a clear preponderance of cancer. Types of surgery were: major abdominal operations (hemicolectomy, hepatic surgery, pancreatectomy), prostatectomy, abdominal hysterectomy for tumor exstirpation, and total hip replacement. Patients diagnosed with chronic pain or taking pain medication or co-analgetics including gabapentine, pregabaline or any type of antidepressants on a regular basis were excluded. The occasional intake of analgesics did not lead to exclusion. In the days before surgery, patients took medication for cardiovascular diseases (44.8%), metabolic diseases (19.0%), urogenital diseases (6.9%), analgesics (5.2%), and medication for other diseases (10.2%). Multiple medications were taken by 24.1%. The perioperative protocol for anesthesia and analgesia is detailed under the section "Assessment of the criterion variables."

Table 1 Indications for surgery

	%
Cancer	
Prostate cancer	29.3
Small and large intestine cancer	27.6
Kidney and urinary tract cancer	13.8
Pancreas cancer	5.2
Stomach cancer	2.0
Ovarian cancer	2.0
Liposarkom of retroperitoneum	2.0
Other diseases	
All	19.0

Due to the poor condition of some of the patients, the test session for assessing the predictor variables before surgery had to be interrupted or aborted in these cases. In consequence, two of the four of the patients missed assessment of single predictor variables. All 58 patients completed either the numerical ratings of acute postoperative pain (N = 56) or the assessment of the number of requested boluses of analgesics (patient-controlled intravenous analgesia [PCIA]; N = 49). Accordingly, a few patients did not provide data on both criterion variables. In cases, which did not clinically allow for using PCIA to provide postoperative analgesia in concert with a basic analgesic treatment (see Assessment of the criterion variables), epidural analgesia was achieved by continuous infusion of 0.125% bupivacaine with 0.75 ug/mL sufentanil at an infusion speed of 4–6 mL/h.

The study protocol was approved by the ethics committee of the medical faculty of the University of Erlangen. All participants gave written informed consent.

Materials and Procedure

In order to assess the psychological predictor variables, a test session took place in the afternoon of the day before

Table 2 Basics statistics of all predictor and criterion variables

	Mean (SD)	Male Mean (SD)	Female Mean (SD)	*T*	*p*
Age (years)	60.53 (9.74)	60.44 (9.53)	61.00 (11.24)	–0.16	0.870
Predictor variables					
Attentional bias pain	7.90 (71.33)	3.79 (56.78)	26.40 (119.60)	–0.58	0.369
Attentional bias social threat	–0.38 (53.40)	–0.64 (48.09)	0.80 (78.16)	–0.08	0.939
Attentional bias positive	2.49 (44.77)	1.21 (41.74)	8.25 (58.86)	–0.45	0.657
PASS	84.16 (37.76)	83.67 (35.93)	86.40 (47.43)	–0.21	0.838
PCS	19.38 (10.27)	19.50 (10.46)	18.80 (9.77)	0.19	0.846
PVAQ	39.95 (13.98)	40.42 (13.87)	37.80 (15.03)	0.53	0.596
STAI state	44.76 (11.64)	42.66 (11.31)	54.00 (8.37)	–2.98	0.004
SOMS	14.52 (14.91)	13.00 (11.47)	21.20 (24.88)	–1.02	0.117
CES-D	16.88 (9.36)	15.89 (9.54)	21.40 (7.29)	–1.72	0.092
Pressure pain threshold	446.57 (237.33)	481.23 (245.17)	287.14 (96.30)	4.11	0.018
Criterion variables					
NRS (postoperative pain)	3.59 (2.70)	3.61 (2.66)	3.50 (2.99)	0.11	0.909
PCIA (piritramid mg)	81.71 (60.67)	81.29 (63.12)	84.29 (47.01)	–0.12	0.905

SD = standard deviation; PASS = Pain Anxiety and Symptom Scale; PCS = Pain Catastrophizing Scale; PVAQ = Pain Vigilance and Awareness Questionnaire; STAI = State-Trait Anxiety Inventory; SOMS = Screening for Somatoform Symptoms; CES-D = Centre for Epidemiologic Studies Depression Scale; NRS = numerical rating scale; PCIA = patient-controlled intravenous analgesia.

surgery. The session, which lasted for approximately 90 minutes, included running the dot-probe task, filling out questionnaires (pain catastrophizing, pain-related anxiety, and pain vigilance), assessment of pressure pain thresholds, and again filling out questionnaires (general anxiety, depression, somatization). Still in the recovery room after surgery, numerical scale ratings (NRS, see below) for pain were recorded every 30 minutes and 30 minutes after each intravenous drug administration. Patients were transferred to the normal ward when the Aldrete score was 8 or higher [11] and when pain was rated 3 or lower on the NRS. Acute postoperative pain was assessed by the mean of NRS ratings in the first hours after surgery (recovery room); furthermore, the amount of requested analgesics (PCIA) was evaluated during the first 2 days after surgery. Table 2 gives an overview about all predictor and criterion variables assessed.

Assessment of the Predictor Variables

Predictor variables were grouped for theoretical reasons into four categories: 1) attentional biases toward emotionally loaded words (dot-probe task); 2) self-report on pain-related emotions and cognitions (pain catastrophizing, pain-related anxiety, pain vigilance); 3) pressure pain threshold; and 4) self-report on emotional and bodily distress (general anxiety, depression and somatization). During the test session these categories were determined in that order and are described below.

Attentional Biases Toward Emotionally Loaded Words (Dot-Probe Task). Attentional biases toward emotionally loaded words were assessed via the dot-probe task described by Keogh et al. [5]. It contains three emotional word categories: pain-related (e.g., stechend/stinging), social threat (e.g., beschämt/ashamed), and positive words (e.g., glücklich/lucky). These words are paired with neutral words (Anstrich/paintwork); neutral–neutral word pairs served as filler items. We translated the words of the original version by Keogh et al. [5] into German. As not all words fulfilled the criteria of being similar in length and frequency of use, a series of words had to be replaced. In a pilot study, it was tested whether each word of the new list (containing more items than necessary) was representative for the designated word category. If this was not the case, these words were excluded from the final use in the dot-probe task.

Following Keogh et al. [5], a fixation cross was presented in the center of a computer screen for 500 ms. Then, two words (a neutral one paired with an emotional one) were presented, one below and one above the fixation cross for another 500 ms. After this, a dot appeared at the location of one of the two words. Subjects were required to indicate as quickly as possible, by pressing one of two keys (below, above), where the dot had appeared. Reaction time was measured. After 20 practice trials, participants had to complete 128 test trials (32 trials per word-pair category), all of which were presented in a random order by the computer. Bias indices were calculated on the basis of reaction times to assess separately the attentional bias toward each emotional word category (for more details, see Keogh et al. [5]). A positive score indicates an attentional preference for the location of the emotional word, which may suggest vigilance, whereas a negative score may suggest avoidance.

Self-Report on Pain-Related Emotions and Cognitions. We tried to assess pain-related emotions and cognitions using three questionnaires, namely the pain catastrophizing scale (PCS [12]), the Pain Anxiety Symptom Scale (PASS [13]) and the pain vigilance and awareness questionnaire (PVAQ [14]).

The PCS [12] was developed as a measure of catastrophizing related to pain. It contains 13 items that can be divided into three subscales, namely rumination, magnification, and helplessness. The items are rated on a 5-point scale. For further analyses, we used the combined sum score of the PCS.

The PASS [13] is composed of four subscales: cognitive anxiety, escape/avoidance, fearful appraisal, and physiological anxiety, and is designed to measure pain anxiety across cognitive, behavioral, and physiological domains. The items are rated on a 6-point scale. For further analyses, we used the combined sum score (40 items) of the PASS.

The PVAQ [14] was developed as a comprehensive measure of attention to pain and has been validated for use in chronic pain and nonclinical samples [15]. It consists of 16 items that are rated on a 6-point scale and which assess awareness, vigilance, preoccupation, and observation of pain. For further analyses, we used the combined sum score of the PVAQ.

With the exception of the PASS (which had been translated into German and validated by Walter et al. [16]) we had to translate the other two questionnaires into German, using a standard "forward-backward" procedure. Only if the resulting backward English version was very similar to the original version according to the evaluation of an English native speaker, translation accuracy was considered sufficient. The intercorrelation of the three German questionnaires ranged between $r = 0.502$ and $r = 0.741$, which is in accordance with intercorrelations reported in the literature for English and Dutch versions [17–20].

Pressure Pain Thresholds. The assessment of pressure pain threshold was performed using a handheld pressure algometer (Algometer type II, Somadic Sales AB, Hörby, Sweden) with a probe area of 1 cm^2. Site of stimulation was the volar site of the right forearm. The pressure was increased from 0 kPa at a rate of change of 50 kPa/s until the subject felt the first pain sensation and pressed a button. There were five trials and the threshold was determined as the average of these trials.

Self-Report on Emotional and Bodily Distress. Emotional and bodily distress was assessed with three different questionnaires, namely the German versions of the Screening for Somatoform Symptoms (SOMS [21]), the German version of the State Anxiety Inventory (STAI state [22]), and the German version of the Center for Epidemiological Studies Depression Scale (CES-D, German version: ADS [23]).

The SOMS [21] is a self-rating scale, which assesses 53 organically unexplained physical symptoms. The state version of the SOMS was applied where subjects are asked to rate the intensity of each symptom and the extent of interference with well-being during the last 7 days on a 5-point Likert scale. For further analyses, we used the sum of all items ("somatization severity index").

The STAI state [22] is a self-rating scale and contains 20 items that were designed to measure transitory anxiety states—that is, subjective feelings of apprehension, tension, and worry that vary in intensity and fluctuate based on the situation. Items are rated on a 5-point rating scale.

The CES-D [23] is a self-rating scale that was designed to assess emotional, somatic and cognitive symptoms of depressive mood during the last week. It contains 20 items that are rated on a 4-point Likert scale.

Assessment of the Criterion Variables

As criterion variables, we assessed patients' self-report ratings of postoperative pain as well as their requests of analgesics (PCIA).

Self-Report of Postoperative Pain. In the recovery room a few hours after surgery, patients were asked in intervals of 30 minutes and 30 minutes after each intravenous drug administration to rate the intensity of their current pain on an 11-point numerical rating scale (NRS). As the stay in the recovery room was variable in hours, the number of ratings obtained was interindividually variable too. The NRS is labeled with the verbal anchors "no pain" and "strongest pain imaginable." The mean of the NRS ratings were entered into further analyses.

PCIA. For a better understanding of the PCIA procedure, the general protocol of anesthesia and analgesia is given first. Patients received a thoracic epidural catheter before induction of general anesthesia. The patient was in a sitting position and puncture of the epidural space was performed at Th7/8 with an 18-gauge needle (Tuohy, B. Braun Melsungen AG, 34209 Melsungen, Germany). After identification of the epidural space with the loss of resistance technique the epidural catheter was inserted and a test dose of 3–4 mL bupivacaine 0.5% was injected. If no signs of spinal anaesthesia were observed after 5 minutes general anesthesia was induced by intravenous injection of sufentanil (10 ug), thiopental (5–7 mg/kg), and *cis*-atracurium (6–10 mg) followed by tracheal intubation. General anesthesia was maintained with the inhalational anesthetic isoflurane or by intravenous propofol infusion (propofol 1%, 6–12 mL/kg/h). After induction of general anesthesia 4–8 mL of a mixture containing 8 mL bupivacaine 0.5% plus 10 ug sufentanil (2 mL Sufentanil 5 ug/mL) was injected epidurally. During surgery epidural top-ups of 2–4 mL of the mixture were given every hour.

Postoperatively, epidural analgesia was achieved during the first hours by continuous infusion of 0.125%

bupivacaine with 0.75 ug/mL sufentanil at an infusion speed of 4–6 mL/h. Thereafter all patients received paracetamol 4*1 g/d intravenously or as a suppository or metamizol 4* 1 g/d intravenously or orally for basic analgesia.

In addition, the patients were instructed to use a PCIA pump. Piritramid boluses of 2 mg (1 mL) could be requested at a lock-out interval of 10 minutes with a 1 hour maximum of 15 mg, a 4-hour maximum of 30 mg and a 24-hour maximum of 60 mg. The patients were instructed to use the pump in a way that prevents higher ratings than 3 on the NRS. The readouts over 48 hours were recorded. The variable of interest was the requested dosage of piritramid over this period.

Statistical Analysis

In case of missing data the patient was not completely excluded from evaluation but only from the analysis containing missing data.

The predictive power of the four categories of predictors, attentional biases toward emotionally loaded words (dot-probe task), self-report on pain-related emotions and cognitions, pressure pain thresholds as well as self-report on emotional and bodily distress was evaluated separately for each category by a separate regression analysis. As we predicted, two criterion variables, namely NRS and PCIA, separately, eight regression analyses in total were run and presented in Table 3. Multivariate R^2 and univariate β coefficients were used for description of the goodness of prediction and tested for significance. As the clinically orientated reader might be especially interested in the prognostic accuracy as regards the postoperative pain outcome, we defined good and poor outcome groups. In a first analysis only patients scoring below the first and above the third quartile in NRS and PCIA were classified as poor and good outcome; this analysis contained mainly the definite cases and set, by that, the easier classification task. In a second analysis all patients were grouped by median-split of the NRS and PCIA scores; this analysis included also the questionable cases and set the more difficult classification task. Thereafter, we computed the classification rates for the two outcome groups (poor vs good), which could be obtained by use of our predictors (see Table 5).

For description of simple relationships, Pearson's correlation coefficients were computed. For comparisons between females and male t-tests for independent samples were used.

Findings were considered to be statistically significant at $\alpha \leq 0.05$.

Results

Clinical Characteristics of the Patients

Descriptive statistics as regards the predictor and criterion variables are given in Table 2. A few findings are worth mentioning here.

Although beyond the scope of the present study, the known sex differences in state anxiety (STAI state) (higher in females) and pain thresholds (lower in females) were found in the present sample, thus suggesting unbiased sampling.

For interpretation of the questionnaire data a comparison with our earlier study [7] on acute postoperative pain in

Table 3 Regression analyses for evaluation of the predictive power of psychological predictors for the prognosis of acute postoperative pain

	R^2			β	
Predictor groups	NRS	PCIA		NRS	PCIA
Attentional biases for emotionally loaded words (dot-probe task)	0.013	0.234*	pain-related	–0.105	0.137
			social threat	–0.056	–0.435**
			positive	0.016	0.224
Pain-related emotions and cognitions	0.048	0.081	PCS	0.062	–0.049
			PASS	0.005	–0.226
			PVAQ	0.191	0.260
Pressure pain threshold	0.072	0.022		0.266	0.149
Emotional and bodily distress	0.048	0.021	SOMS	0.126	0.067
			STAI state	–0.164	–0.153
			CES-D	0.162	0.080

* $P < 0.05$; ** $P < 0.01$.
PASS = Pain Anxiety and Symptom Scale; PCS = Pain Catastrophizing Scale; PVAQ = Pain Vigilance and Awareness Questionnaire; STAI = State-Trait Anxiety Inventory; SOMS = Screening for Somatoform Symptoms; CES-D = Centre for Epidemiologic Studies Depression Scale; NRS = numerical rating scale; PCIA = patient-controlled intravenous analgesia.

Table 4 Pearson correlations between psychological predictor variables

	2	3	4	5	6	7	8	9	10
Attentional biases for emotionally loaded words (dot-probe task)									
1. Pain-related words	–0.028	0.203	0.077	0.093	–0.046	–0.102	–0.084	0.123	0.066
2. Social threat words		0.187	0.131	0.168	–0.063	–0.120	–0.263	0.199	0.117
3. Positive words			–0.262	–0.085	–0.027	–0.113	–0.249	–0.073	–0.084
Pain-related emotions and cognitions									
4. PCS				0.621***	0.300*	0.162	0.172	0.318*	0.280*
5. PASS					0.451***	–0.005	0.380**	0.429***	0.316*
6. PVAQ						0.060	0.230	0.103	0.169
7. Pressure pain threshold							–0.258	–0.128	–0.285*
Emotional and bodily distress									
8. SOMS								0.381**	0.472***
9. STAI state									0.392**
10. CES-D									

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.
PASS = Pain Anxiety and Symptom Scale; PCS = Pain Catastrophizing Scale; PVAQ = Pain Vigilance and Awareness Questionnaire; STAI = State-Trait Anxiety Inventory; SOMS = Screening for Somatoform Symptoms; CES-D = Centre for Epidemiologic Studies Depression Scale.

young male patients undergoing surgical correction of funnel-chest, in which a similar set of variables was recorded, is of interest. Patients in the present study showed only slightly higher scores in most of the questionnaires assessing pain-related emotions and cognitions as well as emotional and bodily distress with one exception. In the present study, CES-D scores were 16.88 on average (the cutoff for defining case status in depression is 16 [24]), and only 9.98 in the former study, which suggests a level of clinically relevant depression in at least some patients of the present study. This finding is not that surprising, considering that cancer was the indication for surgery in around 80% of the patients.

Another comparison of interest was regarding the profile of attentional preferences for emotionally loaded words in the dot-probe task. In our earlier study [7], the ranking from attentional preference to avoidance was social threat words, pain-related words, and positive words. In the present study, the ranking changed to pain-related words, positive words, and social threat words, suggesting that the present patients were most vigilant for pain-related words and attentionally avoiding for social threat words.

Prediction of Acute Postoperative Pain

The results of the regression analyses predicting acute postoperative pain are depicted in Table 3. None of our psychological predictors appeared to be useful in the prognosis of acute postoperative pain with one remarkable exception. The dot-probe task measures together explained significantly the amount of requested analgesics (PCIA use) and accounted for 23% of variance. The best and only significant single predictor out of this category proved to be attentional avoidance of social threat words. A further regression analysis considering age and sex of the patients did not change this pattern of results.

The correlations between our predictor variables showed some typical clusters of relationship within and across certain categories of predictors (see Table 4). Most interestingly, parameters of the dot-probe task, which appeared to be the only good predictors of the PCIA use, were not strongly related to any other predictor. In other words, their contribution to the explanation of acute postoperative pain appeared to be independent from other psychological predictors. Importantly, our two criterion variables, namely NRS rating and PCIA use, were only weakly related ($r = 0.139$, $P = 0.343$), suggesting that they provided independent information about acute postoperative pain.

As a more clinically orientated test on the relevance of our predictors, we computed the classification rates for patients with good and poor outcome as regards their NRS and PCIA scores, which could be obtained by use of our predictors (see Statistical analysis and Table 5). The two corresponding analyses, which once stressed the more extreme outcomes (both good and bad ones) and neglected the cases in between (easy classification task) and which another time used all patients including those with questionable outcomes (difficult classification task), showed again the relevance of attentional avoidance of social threat words in the dot-probe task for prognosis of the PCIA use, which allowed for the maximum of 77% (easy classification task) and of 63% (difficult classification task) correct classifications. The results for the NRS were less consistent. The scores in the PASS and the pressure pain thresholds appeared suitable for prognosis of the more extreme outcomes (easy classification task) by classification rates of 77% and 73%, respectively. The analysis including all patients, also the more questionable outcomes (difficult classification task), found only the attentional avoidance of pain-related words in the dot-probe task to be reasonably good for classification by a rate of 62%.

Table 5 Rate of correct classifications of patients with poor and good postoperative pain outcome (PCIA-Q and NRS-Q: the distinction of poor and good pain outcome was based on the lower and upper quartiles; PCIA-M and NRS-M: the distinction of poor and good pain outcome was based on median split; see also Statistical analysis) by use of single predictors

Predictors	PCIA-Q	PCIA-M	NRS-Q	NRS-M
Attentional bias				
Pain-related	0.67	0.59	0.56	0.62
Social threat	0.77	0.63	0.50	0.45
Positive	0.54	0.57	0.43	0.53
PCS	0.58	0.55	0.57	0.54
PASS	0.64	0.49	0.77	0.50
PVAQ	0.57	0.58	0.67	0.59
Pressure pain threshold	0.42	0.50	0.73	0.58
SOMS	0.53	0.52	0.58	0.53
STAI state	0.36	0.57	0.60	0.53
CES-D	0.60	0.48	0.64	0.56

PASS = Pain Anxiety and Symptom Scale; PCS = Pain Catastrophizing Scale; PVAQ = Pain Vigilance and Awareness Questionnaire; STAI = State-Trait Anxiety Inventory; SOMS = Screening for Somatoform Symptoms; CES-D = Centre for Epidemiologic Studies Depression Scale; NRS = numerical rating scale; PCIA = patient-controlled intravenous analgesia.

Discussion

Psychological predictors of acute postoperative pain were studied in a group of aged persons with mainly malign diagnoses (cancer) as cause of surgery. The exact indications for surgery were heterogeneous. Not surprisingly, the scores for depression were high in these patients, suggesting that some of them had developed clinically relevant depression before surgery. In these patients, psychological prediction of acute postoperative pain appeared to be difficult because a variety of candidates, which has earlier appeared to be successful, failed to provide sufficient prognosis. There was one exception, namely attentional biases toward emotionally loaded words as assessed by the dot-probe task. These biases and especially the attentional avoidance of social threat words allowed significantly predicting the amount of requested analgesics (PCIA use) in the first 2 days after surgery. What might appear as chance finding at first glance is likely a reliable result because similar findings have been obtained earlier in different samples as will be discussed in the following.

In our earlier study [7] on acute postoperative pain in patients with a surgical correction of a funnel-chest, the dot-probe parameters also accounted for a significant proportion of variance in the amount of postoperatively requested analgesics (patient-controlled epidural analgesia, PCEA). The single best parameter was, however, the attentional avoidance of pain-related words. The common denominator of our present and our earlier studies might be that the attentional avoidance of emotionally negative experiences prior to surgery does not ready patients for coping successfully with pain. For note, this occurs at an unconscious and automatic level of stimulus processing. It might depend on the samples investigated that once the attentional avoidance of pain-related words and once the attentional avoidance of social threat words were best predictors. In the earlier study, young patients without major psychological distress but also without major pain experience served as subjects, whereas in the present study moderately depressed patients with mainly cancer diagnoses and probably sufficient pain experiences took part. This might explain why the first group was preoperatively more worried about the impending pain whereas the second group was more concerned about negative evaluations by others. This explanation relies on the assumption that those patients, who attentionally avoided relevant but physically and psychosocially threatening information for pain coping and management before surgery, had poor pain outcome afterward. Alternatively, those patients in the present study, who feared and avoided social threat stimuli, might have felt the strong urge to be “good” patients, supplying sufficient analgesia without the help of others, solely by using the PCIA system. This response bias might have increased the PCIA dosage. The validity of the two explanations cannot be determined by our data.

The question arises whether our findings—reflecting the prediction of self-controlled use of analgesics after surgery by attentional avoidance of aversive stimuli—can be generalized to other indicators of postoperative pain. It is still a widely held belief that the demand of analgesics can be used as an indirect measure of pain [10], although the correlations between this behavioral measure and self-ratings have been found to be low here and in other studies. However, self-ratings have been shown to be also far from being free of judgment biases, which justifies multi-method approaches such as ours for assessing postoperative pain.

We are not the first, finding attentional avoidance of negative experiences to be a significant predictor of postoperative acute pain. Munafò and Stevenson [9] added evidence by use of a different method namely a modified Stroop test. They found in patients with acute postoperative pain due to minor gynecological surgical procedures that the avoiders of pain-related information presented with higher postoperative pain levels. In their case, the prediction was successful also by use of self-reported postoperative pain as criterion whereas in our studies the PCIA use as an indirect behavioral indicator of postoperative pain [10] was best predicted. Interestingly, in a recent study [8] on psychological predictors of persistent forms of postoperative pain in patients with surgical funnel-chest correction we found the preoperative attentional preference for positive words to be a significant predictor of self-reported pain months after surgery. Accordingly, also in our studies prediction is not always limited to indirect behavioral measures of postoperative pain like PCEA or PCIA use. Furthermore, it seems that attentional focusing on positive stimuli and not only defocusing away from negative stimuli may help to distract from pain and may indicate maladaptive preparatory coping with postoperative pain. The underlying mechanism may be a lack of psychological confrontation with the impending situation and a miss of information preparing the patient to cope with pain. Although evidence for the maladaptive role of preoperative, attentional preference for positive stimuli and avoidance of negative stimuli for the development of postoperative pain has now accumulated, replications are required for final conclusions.

Slightly in contrast to other studies and similarly to our earlier study, variables like pain catastrophizing, depression, and general and pain-related anxiety did not prove to be significant predictors of acute postoperative pain [2,3,25,26]. Interestingly, depression did not appear to be a significant predictor of acute postoperative pain in both of our two studies, although the levels of depression were once subclinical and once clinical. However, we would like to refrain from debating these discrepancies between our studies and those of others too intensively because none of these predictor candidates—although definitively of relevance in certain conditions—have been shown to be exclusively decisive as regards the development of acute postoperative pain. Therefore, it is rather the question what is the best combination of these predictors for certain patients and certain surgical procedures given a certain amount of time available for assessment.

A comment is necessary as regards the criterion variables in our study, i.e., self-rated postoperative pain and patients' use of PCIA. The two criteria did not span exactly across the same time window, as PCIA use was assessed during the first 2 days after surgery whereas the ratings of acute pain were recorded only for a few hours after surgery. The correlation between the self-reported postoperative pain and the PCIA use was not surprisingly quite low. The instruction to use the PCIA at a certain pain criterion (NRS > 3) should have led to higher correlations and average pain ratings below 3, which both did not happen. The PCIA use was apparently not only influenced by the experience of pain but also by the expected degree of analgesia, the fear of pain, the fear of using potent analgesics and other variables. Furthermore, a frequent use of the PCIA might have reflected indistinguishably high levels of pain or strong efforts to control any pain. However, none of these theoretical alternatives discredits one of the two criterion measures because both reflect critical variables effective in the management of postoperative pain and distress. Furthermore, also the indirect measure of postoperative pain provided by PCA use has become an established parameter [10].

A limitation of the study might have been the low number of patients for testing a sizeable number of predictors of postoperative pain outcome. Testing seriously ill patients 1 day before surgery is ambitious and explains why we did not end with higher numbers. However, this argument does not heal the statistical problem. Fortunately, the main finding, which suggests that an attentional bias away from threatening stimuli is a good predictor of poor outcome, has now been repeatedly obtained in our studies and could be, by that, considered as replicated.

In sum, the attentional bias in the form of avoidance of negative experiences, namely social threat, prior to surgery was a significant predictor of the amount of request analgesics (PCIA) in the acute phase of postoperative pain in aged patients with mainly malign indications for surgery. As similar results have been obtained in earlier studies on different samples of patients, research on unconscious, implicit and automatic selection of emotionally loaded information may be worth being pursued in the future for a better understanding of the development of postoperative pain.

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