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Associations between postoperative analgesic consumption and distress tolerance, anxiety, depression, and pain catastrophizing: a prospective observational study[☆]

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Abstract
Background: Patients' postoperative treatment might be affected by their psychological state. The study aimed to evaluate the effects of anxiety, coping ability (stress tolerance), depression, and pain catastrophizing on analgesic consumption in patients scheduled for sleeve gastrectomy.
Methods: This prospective observational study consisted of 72 patients. The Distress Tolerance Scale (DTS), Beck Anxiety Inventory (BAI), Beck Depression Inventory (BDI), and Pain Catastrophizing Scale (PCS) were completed in the preoperative period. In the postoperative period, pain intensity, as measured with the Visual Analogue Scale (VAS), and morphine consumption (mg) were evaluated after 2, 6, 8, and 24 hours. Total morphine consumption was recorded.
Results: The results revealed a strong negative correlation between distress tolerance and postoperative total morphine consumption ($r = -0.702$, $p < 0.001$). There was a strong positive correlation between total morphine consumption and pain catastrophizing ($r = 0.801$, $p < 0.001$). A moderate positive correlation was observed between total morphine consumption and anxiety and between total morphine consumption and depression ($r = 0.511$, $p < 0.001$; $r = 0.556$, $p < 0.001$, respectively). Linear regression revealed that distress tolerance, anxiety, depression, and pain catastrophizing are predictors of postoperative morphine consumption ($\beta = 0.597$, $p < 0.001$; $\beta = 0.207$, $p = 0.036$; $\beta = 0.140$, $p = 0.208$; $\beta = 0.624$, $p < 0.001$, respectively).
Conclusions: Distress tolerance, anxiety, depression, and pain catastrophizing can be predictive of postoperative analgesic consumption. In the estimation of postoperative analgesic consumption, distress tolerance, as well as anxiety, depression, and pain catastrophizing, were found to be important predictors.
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Introduction

Pain is a subjective condition that is influenced by several variables, such as psychological, social, cultural, and emotional status.[1] Inadequate postoperative pain control can result in a delayed return to daily living in the early postoperative period and chronic pain in the long term.[2] Interindividual differences in pain and analgesic response present difficulties in postoperative pain treatment.

In a study of patients who underwent abdominal aortic aneurysm repair, Liu et al. found that a high body mass index (BMI) was predictive of preoperative depression.[3] In another study, patients who underwent surgery for obesity experienced psychological consequences, which ranged from loss of self-esteem to clinical depression.[4]

Depression has been associated with acute pain (trauma or acute medical condition) and an increased perception of pain severity.[5] Anxiety is an important predictor of postoperative pain. It lowers pain thresholds and exacerbates pain duration. Previous studies have found an association between higher preoperative anxiety and increased postoperative pain.[6] Although anxiety affects analgesic consumption, there are interindividual differences in postoperative pain and analgesic consumption. Thus, it can be speculated that anxiety would not be sufficient to affect analgesic consumption.[7]

The present study hypothesized that the main factor in analgesic consumption would be the lack of anxiety coping skills rather than the presence of anxiety. The present study aimed to evaluate the relationship between postoperative analgesic consumption and distress tolerance, which refers to the ability to tolerate and to endure negative emotions (i.e., distress), pain catastrophizing, which includes the ability to deal with painful conditions and to eliminate pain, depression, and anxiety, in obese patients scheduled for laparoscopic sleeve gastrectomy.

Methods

This prospective observational study consisted of 72 obese patients scheduled for laparoscopic sleeve gastrectomy between July 2017 and January 2018 (Fig. 1). The study was approved by the Gaziosmanpasa University local ethics committee (17-KAEK-077). The data were a subset of a previously registered study (clinicaltrials.gov; Grant Number: NCT03227315). The STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines were followed. The inclusionary criteria were as follows: age 18–60 years with a BMI of at least 30 kg.m^{-2}, American Society of Anesthesiologists (ASA) physical status I and II, and reading and comprehension ability sufficient to complete the questionnaires. The exclusion criteria were anxiety or depression diagnosis (as indicated in the medical records or patient statements), chronic pain and preoperative analgesic consumption, and contraindications for morphine use. Patients who refused further participation, canceled the procedure, or required open surgery were excluded. To avoid clinical bias, the study was conducted by two experienced surgeons and anesthetists, and it was controlled by a psychiatrist.
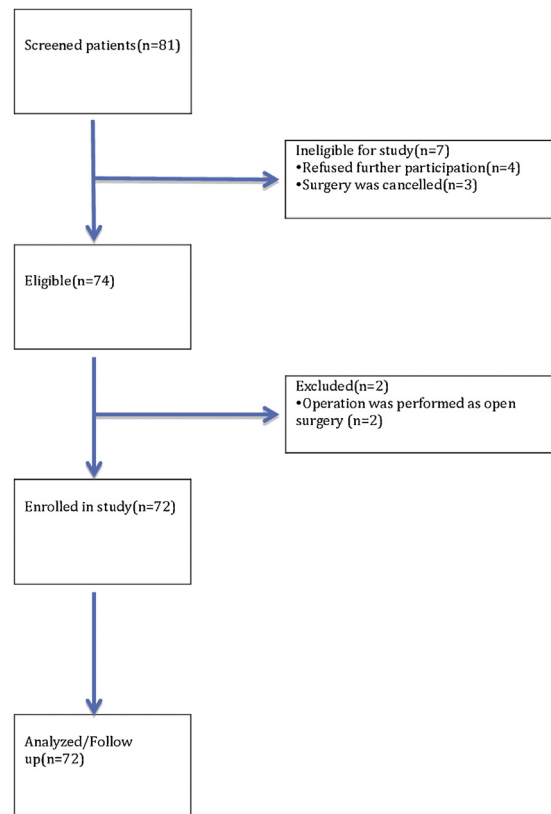

Figure 1 Flow chart. Initially 74 patients of those two were excluded from further analysis because of the intraoperative switch of the surgical technique.

Outcomes

The primary outcome measure was the assessment of the predictive role of distress tolerance in postoperative analgesic consumption and pain intensity. The secondary outcome measure was the assessment of the predictive role of anxiety, depression, and pain catastrophizing in postoperative analgesic consumption and pain intensity.

Measurements

After providing written informed consent, all the patients completed the questionnaires and scales (see below) in the hospital 1 day before surgery. Premedication was not administered before or after the completion of the questionnaire.

Questionnaires and scales

Distress Tolerance Scale

The Distress Tolerance Scale (DTS) developed by Simon et al. is a self-reported measure of the ability to tolerate and to endure negative emotions (i.e., distress). The scale assesses the following areas: (1) tolerability and aversiveness, (2) appraisal and acceptability, (3) tendency to absorb attention and disrupt functioning, and (4) regulation of emotions. It is a 5-point Likert-type scale (1 = *strongly agree*, 2 = *mildly agree*, 3 = *agree and disagree equally*, 4 = *mildly disagree*, and 5 = *strongly disagree*). The DTS comprises 15 items.

High scores indicate the ability to endure adversity.[8] The present study used the Turkish version, which was previously validated by Sargin et al.[9]

Pain Catastrophizing Scale

The Pain Catastrophizing Scale (PCS) is a three-part questionnaire. The first part, rumination, covers the inability to eliminate pain and worry. The second part, magnification, examines the exaggeration of pain-related situations. The third part, helplessness, covers the ability to deal with painful conditions. The questionnaire consists of 13 items. The scores range from 0 to 52 points, with higher values indicating higher levels of pain catastrophizing.[10] Suren et al. validated the Turkish version of the questionnaire.[11]

Beck Anxiety Inventory

Anxiety severity was measured with the Beck Anxiety Inventory (BAI), which was developed by Beck et al.[12] Responses to this questionnaire are indicated on a Likert scale (none, mild, moderate, and serious), with scores ranging from 0 to 63. The clinician assigns the following values to each response: 0 = *not at all*; 1 = *mild*; 2 = *moderate*; 3 = *severe*. A total score of 0–7 is interpreted as a minimal level of anxiety, 8–15 is interpreted as mild, 16–25 as moderate, and 26–63 as severe. Ulusoy et al. validated the Turkish version of this questionnaire.[13]

Beck Depression Inventory

The Beck Depression Inventory (BDI) measures the severity of depressive symptoms.[14] This questionnaire consists of 21 items. Each item is scored from 0 to 3, for a total score of 0 to 63. A total score of 0–10 is interpreted as a normal level of depression, 11–16 is interpreted as mild mood disturbance, 17–20 as borderline clinical depression, 21–30 as moderate depression, 31–40 as severe depression, and > 40 as extreme depression. The questionnaire was previously validated by Hisli.[15]

Visual Analogue Scale

The Visual Analogue Scale (VAS) is a measure of pain severity. It consists of a scale anchored by ''no pain'' (score of 0) and ''worst imaginable pain'' (score of 100).

Intraoperative period

In all patients, general anesthesia was induced via the intravenous administration of 0.6 mg.kg^{-1} of rocuronium bromide, 2 mg.kg^{-1} of propofol, and 1 μg.kg^{-1} of fentanyl. To maintain anesthesia, volatile anesthetic sevoflurane (1 MAC) and a 50% oxygen–50% air mixture were used. During the intraoperative period, morphine was administered in accordance with the patient's ideal body weight. Thus, approximately 6 mg of morphine and 1 g of paracetamol were administered.

Postoperative period

In the postoperative period, a routine analgesic procedure was applied. It involved the administration of 1 g of paracetamol and 100 mg of tramadol 3 times per day. The patients evaluated pain severity on the VAS pain in the recovery room and 2, 6, 8, and 24 hours after surgery. For patients with a self-reported VAS pain greater than 3, the analgesic requirements were fulfilled with the intravenous administration of 2 mg morphine by an anesthesiologist or a nurse. Each patient's total post-surgery morphine consumption was recorded.

Data analysis

In a study by Ali et al.,[16] the total tramadol consumption in patients with high anxiety was found to be 264 ± 29.9 mg. The assumption of an 8% decrease of this dose in patients with low anxiety (accepting a type I error of 0.05 and a power of 0.80) showed that a total of 64 patients was required to discern a statistically significant difference. The normal distribution fitness of the data was assessed with the one-sample Kolmogorov–Smirnov test. The categorical data were expressed as frequencies and percentages, and the quantitative data were expressed as the mean ± standard deviation. The relationship between the questionnaire scores (DTS, PCS, BAI, BDI, and VAS) and analgesic consumption was examined with the Pearson correlation coefficient. The relationships between the variables were evaluated through linear regression. Data analysis was performed in IBM SPSS Statistics for Windows, Version 20.0 (Armonk, NY). Statistical significance was set at $p < 0.05$.

Results

Of the 81 potentially eligible patients who were initially assessed, 72 (19 male, 53 female) were included in the study. The flow diagram presents the recruitment and missing data (Fig. 1). The basic characteristics and the patients' preoperative distress tolerance, depression, anxiety, and pain catastrophizing scores and their postoperative VAS pain and analgesic consumption are presented in Table 1. The average 24 -h morphine consumption was 10.7 ± 8.1 mg. The mean distress tolerance, anxiety, depression, and pain catastrophizing values were 49.1 ± 14.2, 22.4 ± 15.9, 8.2 ± 9.3, and 18.5 ± 12.1, respectively. The distress tolerance, anxiety, depression, and pain catastrophizing scores (min-max) were 18–73, 0–59, 0–41, and 1–47, respectively.

The correlations among the predictors and between the predictors and outcomes are presented in Table 2. The patients' VAS pain and morphine consumption in the recovery room and 2, 6, 8, and 24 hours after surgery are presented in Fig. 2.

The Pearson correlation coefficient indicated that there was a strong negative correlation between distress tolerance and total postoperative analgesic consumption ($r = -0.702$, $p < 0.001$; Fig. 3). There was a strong positive correlation between total morphine consumption and pain catastrophizing ($r = 0.801$, $p < 0.001$; Fig. 3). There was a moderate correlation between total analgesic consumption and anxiety and depression ($r = 0.511$, $p < 0.001$; $r = 0.556$, $p < 0.001$, respectively; Fig. 4).

The multiple linear regression analysis revealed that distress tolerance, anxiety, depression, and pain catastrophizing were important predictors of postoperative morphine consumption ($\beta = -0.597$, $p < 0.001$; $\beta = 0.207$, $p = 0.036$; $\beta = 0.140$, $p = 0.208$; $\beta = 0.624$, $p < 0.001$,

Table 1 Descriptive analysis of the demographics, predictors, and outcomes.

Variable			n	%	Mean (SD)
Demographics	Gender	Male	19	26.4	
		Female	53	73.6	
	Age (years)				35.5 (10.1)
	Weight (kg)				125.5 (24.9)
	Height (cm)				165.7 (9.9)
	BMI (kg.m^{-2})				45.5 (6.3)
Predictors	Distress tolarance				49.1 (14.2)
	Anxiety				22.4 (15.9)
	Depression				8.2 (9.3)
	Pain catastrophizing				18.5 (12.1)
Outcomes	VAS pain recovery room				4.6 (1.8)
	VAS pain at 2 h				4.9 (1.6)
	VAS pain at 6 h				3.8 (1.7)
	VAS pain at 8 h				3.4 (1.6)
	VAS pain at 24 h				2.4 (1.3)
	Morphine consumption at recovery room				2.6 (3.6)
	Morphine consumption at 2 h				3.3 (1.9)
	Morphine consumption at 6 h				2.0 (1.9)
	Morphine consumption at 8 h				1.8 (1.9)
	Morphine consumption at 24 h				1.0 (1.4)
	Total morphine consumption (mg)				10.7 (8.1)

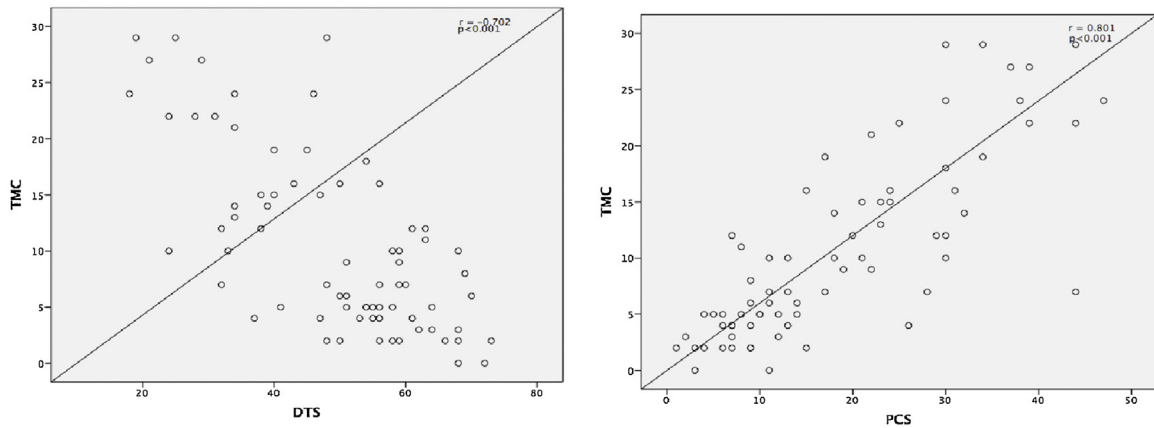VAS, Visual analogue scale; BMI, Body mass index.

Figure 3 Correlations between analgesic consumption and effect of coping ability and pain catastrophizing on postoperative period. TMC, Total morphine consumption (mg); DTS, Distress Tolerance Scale; PCS, Pain Catastrophizing Scale.
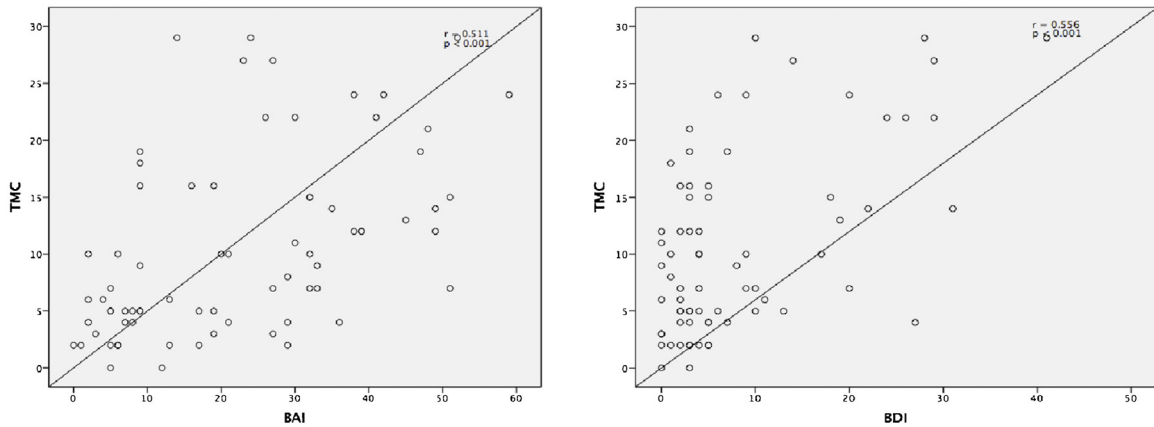

Figure 4 Correlations between analgesic consumption and effect of anxiety and depression on postoperative period. TMC, Total morphine consumption (mg); BAI, Beck anxiety inventory; BDI, Beck depression inventory.

Table 2 Correlations among predictors and outcomes.

Predictors	Predictors or outcomes	n	Correlation coefficients	p value
Distress tolerance	Anxiety	72	-0.510	<0.001
	Depression	72	-0.645	<0.001
	Pain catastrophizing	72	-0.791	<0.001
	VAS pain in the recovery room	72	-0.516	<0.001
	VAS pain at 2 h	72	-0.483	<0.001
	VAS pain at 6 h	72	-0.628	<0.001
	VAS pain at 8 h	72	-0.671	<0.001
	VAS pain at 24 h	72	-0.690	<0.001
	Morphine consumption in the recovery room (mg)	72	-0.543	<0.001
	Morphine consumption at 2 h (mg)	72	-0.468	<0.001
	Morphine consumption at 6 h (mg)	72	-0.642	<0.001
	Morphine consumption at 8 h (mg)	72	-0.705	<0.001
	Morphine consumption at 24 h (mg)	72	-0.726	<0.001
	Total morphine consumption (mg)	72	-0.702	<0.001
Anxiety	VAS pain in the recovery room	72	0.359	0.002
	VAS pain at 2 h	72	0.641	<0.001
	VAS pain at 6 h	72	0.395	<0.001
	VAS pain at 8 h	72	0.467	<0.001
	VAS pain at 24 h	72	0.608	<0.001
	Morphine consumption in the recovery room (mg)	72	0.330	0.005
	Morphine consumption at 2 h (mg)	72	0.512	<0.001
	Morphine consumption at 6 h (mg)	72	0.422	<0.001
	Morphine consumption at 8 h (mg)	72	0.477	<0.001
	Morphine consumption at 24 h (mg)	72	0.493	<0.001
	Total morphine consumption (mg)	72	0.511	<0.001
Depression	VAS pain in the recovery room	72	0.548	<0.001
	VAS pain at 2 h	72	0.486	<0.001
	VAS pain at 6 h	72	0.512	<0.001
	VAS pain at 8 h	72	0.551	<0.001
	VAS pain at 24 h	72	0.544	<0.001
	Morphine consumption in the recovery room (mg)	72	0.515	<0.001
	Morphine consumption at 2 h (mg)	72	0.388	<0.001
	Morphine consumption at 6 h (mg)	72	0.415	<0.001
	Morphine consumption at 8 h (mg)	72	0.568	<0.001
	Morphine consumption at 24 h (mg)	72	0.558	<0.001
	Total morphine consumption (mg)	72	0.556	<0.001
Pain catastrophizing	VAS pain in the recovery room	72	0.588	<0.001
	VAS pain at 2 h	72	0.651	<0.001
	VAS pain at 6 h	72	0.717	<0.001
	VAS pain at 8 h	72	0.779	<0.001
	VAS pain at 24 h	72	0.775	<0.001
	Morphine consumption at recovery room (mg)	72	0.613	<0.001
	Morphine consumption at 2 h (mg)	72	0.589	<0.001
	Morphine consumption at 6 h (mg)	72	0.733	<0.001
	Morphine consumption at 8 h (mg)	72	0.805	<0.001
	Morphine consumption at 24 h (mg)	72	0.760	<0.001
	Total morphine consumption (mg)	72	0.801	<0.001
VAS pain	Morphine consumption at recovery room (mg)	72	0.907	<0.001
	Morphine consumption at 2 h (mg)	72	0.887	<0.001
	Morphine consumption at 6 h (mg)	72	0.914	<0.001
	Morphine consumption at 8 h (mg)	72	0.906	<0.001
	Morphine consumption at 24 h (mg)	72	0.858	<0.001
	Total morphine consumption (mg)	72	0.950	<0.001

VAS, Visual analogue scale.

Table 3 Regression analysis between predictors and total morphine consumption.

Outcome	Predictors	N	β	p value
Total morphine consumption (mg)	Distress tolerance	72	−0.597	<0.001
	Anxiety	72	−0.207	0.036
	Depression	72	0.140	0.208
	Pain catastrophizing	72	0.624	<0.001
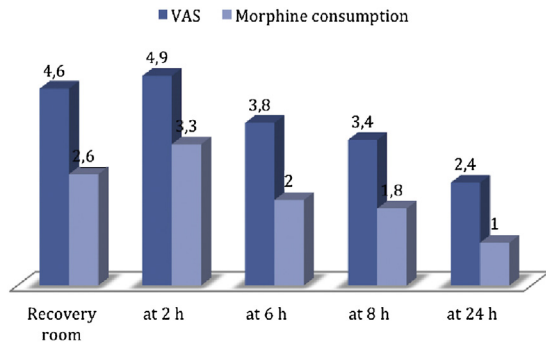
Figure 2 Total morphine (mg) and VAS according to the postoperative follow-up time of the patients. VAS, Visual Analogue Scale.

respectively; Table 3). There was a strong positive correlation between the VAS pain and total postoperative analgesic consumption in the recovery room and 2, 6, 8, and 24 hours after surgery (r = 0.907, p < 0.001; r = 0.887, p < 0.001; r = 0.914, p < 0.001; r = 0.906, p < 0.001; r = 0.858, p < 0.001; r = 0.950, p < 0.001, respectively; Table 2).

Discussion

A review of the literature indicates that the present study is the first to apply the Distress Tolerance Scale to surgical patients. One of the most important findings was the predictive role of distress tolerance, which is a measurement of stress coping ability, tolerance, and acceptance, in the determination of postoperative analgesic requirements.

Patients with anxiety require higher drug doses for anesthesia induction and analgesia. Some studies have found a correlation between preoperative anxiety and postoperative pain; however, this has been contradicted by other studies.[17] According to the literature, psychological factors may explain the differences in postoperative pain intensity and analgesic requirements.[18] These psychological factors include patients' approaches to managing preoperative stress. Thought avoidance regarding a planned surgical procedure resulted in dramatically reduced preoperative anxiety and postoperative recovery.[19] In a study of gynecological laparoscopy patients, Cohen et al. demonstrated that the morphine dosage in the first 48 hours after surgery was affected by stress and stress mitigation techniques. The same study showed that preoperative stress, emotional support, and self-reassurance based on religious convictions were predictive of pain levels 4 weeks after surgery.[20]

Kjolhede et al. examined low and high stress capacity through the administration of the Stress Coping Inventory questionnaire to 162 fast-tracked abdominal hysterectomy patients. The high-stress-capacity patients exhibited lower pain intensity in the surgical area, lower intensity of troublesome symptoms, and less fatigue.[21] Emami et al. found that low distress tolerance was a risk factor for unhealthy eating. The identification of the factors in the link between distress tolerance and unhealthy eating is important for the treatment of obesity and eating disorders.[22] In bariatric surgery patients, low distress tolerance has been found to be associated with depression and anxiety symptoms, disordered eating behaviors, and high BMI. The same study found higher levels of psychological distress in individuals who underwent bariatric surgery. Dialectical behavioral therapy and/or acceptance and commitment therapy have been suggested as options for increasing distress tolerance.[23]

Acceptance means not only overcoming painful situations but also coping with unpleasant situations. It plays an important role in the ability to successfully cope with acute and chronic pain. In acute pain induction, high acceptance was found to be related to higher pain tolerance.[24] In the present study, in accordance with the above information, high distress tolerance scores were negatively correlated with lower analgesic use. The ability to cope with painful and unpleasant situations is an important marker for postoperative analgesia consumption.

Preoperative anxiety is a common occurrence. High anxiety levels can lead to greater postoperative pain and, thus, the need for analgesia. An observational study of 127 adult orthopedic and trauma patients found that anxiety was a predictive risk factor for moderate to severe postoperative pain.[25] A study of the relationship between preoperative anxiety and postoperative pain control in laparoscopic cholecystectomy patients found that those who exhibited greater anxiety had higher postoperative Visual Analogue Scale pain values and analgesic consumption.[16] The results on anxiety in the present study are consistent with those of previous investigations and show that anxiety is a predictor of postoperative pain.

Studies of depression as a prospective predictor of postoperative acute, chronic, and persistent pain found increased pain perception and opioid consumption following total joint arthroplasty in patients with major depressive disorder.[26] De Cosmo et al. found that preoperative depression was significantly correlated with postoperative pain intensity and analgesic requirements.[27] The present study yielded similar results. Depression resulted in higher postoperative Visual Analogue Scale pain and analgesia requirements.

The Pain Catastrophizing Scale was developed to measure individual pain catastrophizing. Pain catastrophizing scores have been found to be predictive of post-trauma variables, such as severe pain and emotional disturbance.[28] Strulov et al. found a positive correlation between preoperative

pain catastrophizing and pain intensity and analgesic use in the first 2 days after a cesarean section.[1] The present study found a positive relationship between not only pain catastrophizing and postoperative analgesic use but also pain catastrophizing and distress tolerance values. This suggests that pain catastrophizing values are an indicator of postoperative analgesic use.

The Visual Analogue Scale pain has been used for evaluating postoperative pain and analgesic requirements. Analgesic drugs are started at a visual analogue scale pain of 3 or 4.[29] In the present study, in which morphine was started in patients with Visual Analogue Scale pain greater than 3, there was a positive correlation between the Visual Analogue Scale pain and morphine consumption.

A limitation of this prospective study is the relatively small sample size. Thus, the use of larger sample sizes might be beneficial in future studies.

Conclusion

In sum, distress tolerance, anxiety, depression, and pain catastrophizing are important predictors of postoperative analgesic consumption.

Conflicts of interest

The authors declare no conflict of interest.

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