

The application of preoperative self-anticipating pain scores in predicting surgical pain after elective surgery

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Abstract

Background Current principles of postoperative pain management are primarily based on the types and extent of surgical intervention. This clinical study measured patient's self-anticipating pain score before operation, and correlated the scores with the actual pain levels and analgesic requirement after operation.

Methods This prospective cross-sectional, observational study recruited consecutive patients who received elective surgery in the E-Da Hospital, Taiwan from June to August 2018. Patients were invited to complete a structured questionnaire during preoperative anesthesia assessment that surveyed patient's self-anticipating pain level (numeric rating scale, NRS 0-10) for the scheduled procedure. The actual pain score (visual analogue scale, VAS) experienced by the patient and the total equivalent dose of opioids administered after operation were recorded.

Results A total of 996 patients were recruited and 1 patients were excluded due to incomplete data. Most of the patients (86%) received general anesthesia and 73.9% of them had prior operation history. Patients with younger ages (<40 years) and those took regular benzodiazepine for sleep disorder anticipated significantly higher pain levels. Male patients anticipated significantly lower NRS than females (odd ratio 1.710; 95% CI 1.254-2.331). Patients who scheduled for laparotomy, orthopedic surgery or long procedures had higher anticipating NRS. Although higher anticipating NRS were associated with higher postoperative VAS scores and higher total equivalent opioid dose for acute pain management, these surgical patients actually experienced less VAS than they anticipated at the post-anesthesia care unit.

Conclusion This observational study found that female, younger age (<40 years), regular benzodiazepine user and patients who scheduled for long procedure (>2 h), laparotomy or orthopedic surgery are anticipating significantly higher surgical-related pain. Therefore, appropriate preoperative counseling for analgesic control and elimination of unnecessary anticipating pain levels in these patients would be necessary to improve the quality of anesthesia service and patient's satisfaction.

Background

Inadequate postoperative pain management can lead to physical and psychological distress in patients as well as impact surgical wound healing [1–3] and increase the risk of developing postoperative delirium [4] and cardiopulmonary and thromboembolic events [5]. Severe postoperative pain may also result in the development of chronic pain, which in turn can lead to prolonged use of opioids and increased health-care costs [6]. Although clinical pathways and strategies have been recently implemented, including the introduction of the enhanced recovery after surgery (ERAS) program and multimodal analgesia (MMA), rates of inadequate postoperative pain management remain as high as 40-56.4% in the general surgical population [7, 8] and the prevalence rates of persistent pain after major operations can reach up to 50% [1].

Several perioperative factors such as age, catastrophizing pain scores, gender, and psychological distress have been suggested to be closely associated with patient pain perception before operations [9–11].

Preoperative expectations of pain may also affect the severity of postoperative pain [12–16]. However, most studies on postoperative pain have limited their focus to certain operations and include relatively small patient numbers. Therefore, the aim of this clinical observational study was to characterize the patient pain perception by measuring patients' self-anticipated pain score in a larger scale or surgical population, and to correlate the preoperative anticipated pain scores with the actual pain levels and analgesic requirements after surgery.

Methods

Study population and study protocol

This prospective cross-sectional, observational study was approved by the ethics committee and the institutional review board of E-Da Hospital, Taiwan (approval number EMRP107018). Consecutive patients who received elective surgery under general or regional anesthesia during June 2018 to August 2018 were included in this study. Patients scheduled for emergency operations or those who required postoperative intensive care were excluded. Patients were invited to voluntarily complete a structured questionnaire during their preoperative anesthesia assessment. In this questionnaire, patients were asked to report their highest subjective anticipated postoperative pain level (numeric rating scale (NRS) 0-10). Patients admitted to the postoperative care unit (PACU) had their pain levels assessed using the visual analogue scale (VAS) by nurse specialists at 15-minute intervals. The total analgesic dosages administered in the operating room and in the PACU were also recorded. All anesthetic and surgical interventions, including procedures and medications, administered in this study followed standard clinical practice protocol or physician's decision. The equivalent doses of opioids used during the perioperative period was calculated according to the updated practical opioid rotation and equianalgesic tables [17]. A culturally relevant depression screening questionnaire, the Taiwanese Depression Questionnaire (TDQ), was used for the assessment of depression in the surgical patients [18].

Statistics

Anticipating NRS ≥ 4 during preoperative assessment and the actual VAS ≥ 4 measured at PACU were defined as high pain levels or inadequate pain control [5]. Patients' anticipating NRS were correlated with patient demographical data, anesthesia and surgical-related factors. The values of continuous variables were compared using an independent two-sample t test, one-way ANOVA or Wilcoxon rank-sum test, as appropriate. Categorical variables were compared using chi-square or Fisher's exact test. Conditional logistic regression model was adopted to evaluate the associated factors (patient demographic and clinical variables) and the preoperative anticipating pain scales. Statistical significance was accepted at a level of $P < 0.05$. All statistical analyses were performed using the SAS software, version 9.1 (SPSS software, version 24.0 (IBM, Armonk, NY)).

Results

General outcomes

A total of 996 eligible patients were included in the study, one patient was excluded due to incomplete data. The mean age of the study population was 50.9 ± 15.6 years and 50.9% of the patients were male (Table 1). Most of these patients (86%) received general anesthesia for their procedures and 73.9% of them had at least one previous surgery (Table 1). Operation types are listed in Table 1. The mean anticipated pain NRS score before surgery was 4.9 ± 2.6 (range 0-10) and 71.1% of the patients anticipated high postoperative NRS scores (³4) (Table 1).

Patient characteristics and preoperative self-anticipated pain

Female patients anticipated significantly higher pain levels than male patients with an adjusted odds ratio (AOR) of 1.978 (95% confidence interval (CI) 1.492-2.622) (Table 2). Compared with younger patients, patients over 41 years of age had significantly fewer concerns about postoperative pain (Table 2). Patients with a higher American Society of Anesthesiologists physical class (ASA PC ³III) and a history of previous operations were associated with lower anticipated NRS scores (Table 2). Patients who were taking regular benzodiazepines for sleep disorders had significantly higher anticipated pain levels. Education level and depression did not affect anticipated pain scores (Table 2).

Surgical factors and preoperative self-anticipated pain

Compared with laparoscopic surgeries, patients scheduled for laparotomic surgeries were associated with significantly higher anticipated NRS scores (AOR 2.836, 95% CI 1.198-6.712). Patients scheduled for uroscopies and hysteroscopic procedures anticipated significantly lower pain levels (AOR 0.528, 95% CI 0.333-0.839) (Table 3). Longer surgical procedures (>2 h) were associated with significantly increased anticipated NRS scores (Table 3). Compared with general anesthesia, procedures performed under regional anesthesia (neuroaxial or peripheral nerve blocks) significantly reduced patients' anticipated pain scale scores (AOR 0.674; 95% CI 0.462-0.983) (Table 3).

Association between preoperative anticipated pain and postoperative pain

The VAS recorded by PACU nurses showed that 58.1% of patients had adequate pain control (highest VAS \leq 3) within one hour after surgery (Table 4). Before surgery, 41.6% and 24.3% of patients respectively anticipated moderate (4-6) and high (³ 7) NRS scores (Table 4). However, only 1.0% of patients actually experienced high pain levels (highest VAS ³ 7) while in PACU, 40.8% of patients experienced moderate surgical pain in PACU (highest VAS 4-6) (Table 4). Equivalent opioid doses administered during surgery and at PACU was used as an alternative indicator of postoperative pain level. Patients who anticipated higher NRS scores before surgery received significantly higher total equivalent opioid doses during surgery and in PACU (Table 5).

Conditional logistic regression analysis of perioperative factors for preoperative anticipated NRS

Following a conditional multivariate logistic regression analysis, female gender was associated with significantly higher anticipated NRS scores and older age (>40 years) was associated with lower anticipated NRS score with odds ratios of 1.710 (95% CI 1.254-2.331) and 0.670 (95% CI 0.456-0.986) respectively (Table 6). Furthermore, patients who took regular benzodiazepines were associated with significantly higher anticipated NRS scores (Table 6). Laparotomies, orthopedic surgeries, and prolonged operation times (> 2 h) were independent perioperative factors that were associated with higher anticipated pain scale scores in general surgical patients (Table 6).

Discussion

It remains common clinical practice to prescribe perioperative pain management based primarily on the type and invasiveness of surgery. One of the limitations in postoperative pain management has been the fact that the patient's personal perception of pain may not always be taken into account during preoperative pain counseling, as acute postoperative pain is a subjective and multidimensional experience that is extremely hard to measure and manage optimally. The results of this study demonstrated that female patients, younger patients, patients with sleep disorders, and patients scheduled for laparotomic/orthopedic surgery or long procedures are especially concerned about inadequate pain control after surgery. Although it was not identified as an independent factor in multivariate analysis, the use of regional anesthetic techniques has a potential role in relieving patient concerns on postoperative pain.

Gender is commonly considered as a strong predictor for pain perception and analgesic requirements after surgery [19,20]. However, other systematic reviews have not found gender to be an independent predictor for postoperative pain levels or analgesic requirements [11]. The results of our survey suggests that female patients anticipated significantly higher pain levels preoperatively than male patients, the difference remained statistically significant following a multivariate regression analysis with an odds ratio of 1.710 (95% CI 1.254-2.331). These results are congruent with the findings of numerous previous studies [21-23]. Our study also indicated that older patients (>40 years) anticipated a lesser degree of surgery-related pain during their preoperative assessments as compared to younger patients. We suggest that this may be due to the elderly having less preoperative anxiety and requesting for less information concerning the operation [24-26]. Since a history of previous surgery is usually associated with decreased preoperative anxiety [27,28], it was expected to find that previous surgery had a diminishing effect on preoperative anticipated pain levels. Our findings were also consistent with the observation that preoperative anxiety is negatively correlated with preoperative pain expectations [29].

Previous studies have suggested that patients with psychosomatic and behavioral disorders (*e.g.* major depression, insomnia, and pain catastrophization) can have decreased tolerances for postoperative pain [30-33]. Our study has found that regular benzodiazepines for sleep disorder management is an independent risk factor for high anticipated NRS scores during preoperative assessments. However, no differences were found in preoperative pain anticipation between surgical patients with and without depression.

Several perioperative factors were surveyed for their effects on anticipated pain levels. Consistent with other clinical studies, our analysis identified that patients scheduled for laparotomies, spinal, and orthopedic surgeries anticipated higher pain scores than those receiving laparoscopic procedures [34-36]. On the other hand, patients receiving uroscopies and hysteroscopies anticipated less surgical pain. Compared with general anesthesia, regional blocks significantly attenuated patient concerns regarding postoperative pain. Prolonged operation times was also an independent risk factor for increased anticipated pain. These findings support the general concept that the invasiveness and duration of an operation can affect patients' anticipated perception of surgical-related pain in the preoperative period [11].

The preoperative anticipating NRS were correlated to the highest postoperative VAS quantified by the PACU nurses, and the total equivalent dose of opioids prescribed perioperatively. Since patient's anticipating pain scale was not recorded in the clinical notes and the clinical anesthesia team did not aware of the preoperative NRS, the establishment of relationships between preoperative anticipating NRS and the actual postoperative pain levels could be clinically valuable. Our analysis found that patients anticipated significantly more pain preoperatively than they actually experienced after surgery. This was particularly evident in patients who anticipated severe pain (NRS³ 7) preoperatively, these patients were actually more likely to report a lower VAS in PACU. Although there was a positive relationship between preoperative NRS scores and perioperative total equivalent dose of opioid administered (during surgery and in PACU), the correlation coefficient was extremely low. These observations suggests that patients tend to overestimate surgery-related pain levels. However, anesthesiologists are still more likely to prescribe postoperative analgesics based on the type and duration of the operation rather than the patient's subjective perception of pain.

After extensively reviewing 48 studies, Ip *et al.* identified several independent perioperative factors for predicting actual levels of postoperative pain and analgesic usage [11]. These predictive factors include the presence of preoperative pain, anxiety, age, and type of surgery (*i.e.* major joint, thoracic, and open abdominal surgery) and are associated with higher postoperative pain scores; surgery type, age, and psychological distress were found to be significant predictors of analgesic usage. Ip and colleagues' systematic review found that gender had a neutral effect on postoperative pain levels and analgesic requirements, but the results of our study indicated that females anticipated more postoperative pain preoperatively. This major discrepancy could be due to the general understanding that female patients can react more emotionally to physical distress, but the distress is no less authentic or ill than the male patients [37].

The results of this study must be interpreted in light of several limitations. Firstly, this study aimed to determine patients' subjective anticipation of pain preoperatively and to identify the predictive factors for anticipating severe postoperative pain. The results of our study may not be generalizable to actual postoperative pain levels and analgesic requirements. Secondly, perioperative pain was managed based on clinical practice guidelines in this study [38,39], rather than being based on preoperative anticipated pain. Therefore, we did not find any significant relationships between preoperative anticipated NRS

scores and postoperative VAS scores or analgesic requirements. Thirdly, the preoperative questionnaires used to evaluate psychological conditions were designed to be simple and practical so that it could be applied to the general population in a time-efficient manner. The comprehensive versions for diagnosing depression and chronic insomnia were not used in this study. Therefore, this study may have been underpowered to isolate depression as an independent risk factor for anticipating severe postoperative pain. Lastly, our results were not generalized to critically ill patients who were scheduled for postoperative intensive care.

By identifying the predictive factors for anticipating severe postoperative pain, our study demonstrated that factors such as female gender, younger age (< 40 years), regular benzodiazepine use, prolonged operation times (> 2 h), operation type (*e.g.* laparotomy and orthopedic surgery) are significant risk factors for higher anticipated postoperative pain. Therefore, these patients may require additional assessments and pain management counseling during their pre-anesthesia consultation. Appropriate preoperative counseling for analgesic control (especially the introduction of multimodal analgesia) and the elimination of unnecessary anticipated pain levels could improve the quality of anesthesia service and patient perioperative satisfaction.

Abbreviations

AOR: adjusted odds ratio; ASA PS: American Society for Anesthesiologist physical statuses; BMI: body mass index; CI: confidence interval; ERAS: enhanced recovery after surgery; MMA: multimodal analgesia; NRS: numeric rating scale; PACU: postanesthesia care unit; TDQ: the Taiwanese Depression Questionnaire; VAS: visual analogue scale

Declarations

Ethics approval and consent to participate: The study protocol was approved by the institutional review board of the E-Da Hospital, Kaohsiung, Taiwan (EMRP107018). Written informed consents were obtained from the patients or their legal representatives.

Consent for publication: not applicable

Availability of data and material: The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: WSC, SCC, CFL and YCT designed the study. WSC, YTH, MCC, and YCC collected the questionnaires and data acquisition. WSC, TSC, CFL and YCT contributed to the statistical analysis and interpretation of data. WSC, YTH, MCC, CFL and YCT contributed to drafting the manuscript. All authors read and approved the final version of manuscript. CFL and YCT contributed equally to the work.

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Tables

Table 1. Patient demographical data

Characteristics	n (%) or mean±SD
Age (years, mean)	50.9±15.6
Age groups (years)	
<40	262 (26.3%)
40~60	438 (44%)
60~80	271 (27.2%)
>80	25 (2.5%)
Gender	
Male	507 (50.9%)
Female	489 (49.1%)
Body height (cm)	162.1±11.3
Body weight (kg)	68.6±16.4
Body mass index (kg/cm ²)	
< 24.5	441 (44.3%)
≥ 24.5	555 (55.7%)
Educational levels	
Illiteracy	41 (4.1%)
< College or high school	634 (63.7%)
≥ University	321 (32.2%)
Depression (Y)	105 (10.5%)
Surgical history (Y)	736 (73.9%)
Anticipating pain (NRS) level	4.9±2.6
High anticipating pain (NRS ≥4)	708 (71.7%)
Types of anesthesia	
General anesthesia	857 (86.0%)
Regional anesthesia	139 (14.0%)
ASA physical status	
I-II	831 (83.4%)
III-V	165 (16.6%)
Types of operation	
Laparoscopic surgery	163 (16.4%)
Spine surgery	133 (13.4%)
Breast and plastic surgery	85 (8.5%)
Orthopedic surgery	179 (18.0%)
Laparotomy surgery	56 (5.6%)
Other surgeries	379 (38.1%)

ASA: American Society of Anesthesiologists; NRS: numeric rating scale; Y: yes

Table.2 Patient's predicting factors for inadequate pain control after operation (preoperative anticipating pain scale ≥4)

	AOR	95% CI
Gender (F:M)	1.978	1.492-2.622
Age (years)		
0-40	Ref	
41-60	0.609	0.425-0.874
> 61	0.542	0.369-0.796
Previous surgical history (Y:N)	0.823	0.598-1.134
Regular use of benzodiazepine (Y:N)	1.614	1.023-2.546
Depression (Y:N)	1.016	0.990-1.042
Educational levels		
Illiteracy	Ref	
< College or high school	1.074	0.545-2.119
□ University	1.376	0.680-2.782
ASA physical class		
III-V : I-II	0.742	0.519-1.059

ASA: American Society of Anesthesiologists; N: no; Y: yes

Table.3 Surgical and anesthesia predicting factors for inadequate pain control after operation (preoperative anticipating pain scale □4)

	Adjusted odd ratio	95% CI
Types of surgery		
Laparoscopic surgery	Ref	
Spine surgery	1.266	0.751-2.136
Breast and plastic surgery	1.030	0.576-1.842
Orthopedic surgery	1.322	0.814-2.145
Laparotomy surgery	2.836	1.198-6.712
Head-and-neck and dental surgery	0.920	0.569-1.486
Uroscopy and hysteroscopy	0.528	0.333-0.839
Other surgery	1.216	0.629-2.351
Operation time (h)		
£ 2	ref	
2-4	1.888	1.401-2.545
> 4	1.935	1.249-2.997
Types of anesthesia		
Regional : general anesthesia	0.674	0.462-0.983

Table.4 Self-anticipating pain vs highest pain score*

	Preoperative self-anticipating pain score			P value =0.021
	VAS £3	VAS 4-6	VAS 7-10	
Highest pain score at PACU				
VAS £3	184 (18.6%)	260 (26.3%)	130 (13.2%)	574 (58.2%)
VAS 4-6	97 (10.0%)	201 (20.4%)	105 (10.6%)	403 (40.8%)
VAS 7-10	1 (0.1%)	4 (0.4%)	5 (0.5%)	10 (1.0%)
Total patients	282 (28.6%)	411 (41.6%)	240 (24.3%)	

*A total of 987 patients were included in this analysis due to missing data. PACU: postanesthesia care unit; VAS: visual analogue scale

Table.5 Self-anticipating pain vs opioid equivalent dose

	Preoperative self-anticipating pain score			P value
	VAS £3	VAS 4-6	VAS 7-10	
Intraoperative opioid equivalent dose (mg)	10.5±7.0	12.0±8.0	12.3±8.0	0.012
Opioid equivalent dose (mg) at PACU	2.3±3.0	3.0±3.5	3.3±7.1	0.023
Total perioperative opioid equivalent dose (mg)	12.8±8.2	15.0±9.2	15.3±9.1	0.001

*A total of 987 patients were included in this analysis due to missing data. Data are presented as mean±SD; PACU: postanesthesia care unit; VAS: visual analogue scale

Table.6 multiple variation analysis for patient, surgical and anesthesia predicting factors for inadequate pain control after operation (preoperative anticipating pain scale [4])

	AOR	95% CI
Gender (F:M)	1.710	1.254-2.331
Age (years)		
0-40	Ref	
>40	0.670	0.456-0.986
Previous surgical history (Y:N)	0.813	0.575-1.149
Regular use of benzodiazepine (Y:N)	1.651	1.015-2.687
Depression (Y:N)	1.016	0.988-1.045
Educational levels		
Illiteracy	Ref	
< College or high school	1.268	0.607-2.651
□ University	1.441	0.652-3.182
ASA physical status		
III-V : I-II	0.804	0.543-1.190
Types of surgery		
Laparoscopic surgery	Ref	
Spine surgery	1.319	0.749-2.322
Breast and plastic surgery	1.274	0.689-2.355
Orthopedic surgery	1.724	1.025-2.898
Laparotomy surgery	2.591	1.061-6.330
Head-and-neck and dental surgery	1.135	0.683-1.887
Uroscopy and hysteroscopy	0.850	0.505-1.431
Other surgery	1.952	0.947-4.023
Operation time (h)		
£ 2	Ref	
2-4	1.795	1.299-2.482
> 4	1.870	1.145-3.053
Types of anesthesia		
Regional : general anesthesia	0.827	0.523-1.305

ASA: American Society of Anesthesiologists; N: no; Y: yes