Pain Catastrophizing as a Predictor for Postoperative Opioid Requirements for Breakthrough Pain in Patients Undergoing Elective Surgery admitted in a Private Institution from January 2021 to June 2021

Jeena Megan T. Tanco, MD

Abstract

Background: Post-operative pain management is a major challenge encountered by anesthesiologists. Opioids remain to be the most frequently administered analgesic for acute pain despite its many untoward side effects. Little is known about pre-operative pain perception and the psychophysiologic aspects of pain control and response, such as Pain Catastrophizing. The observer aims to identify if pain catastrophizing could be a good predictor for post-operative opioid requirement for breakthrough pain.

Methods: Patients scheduled for elective surgery were stratified pre-operatively as Catastrophizers and Non-Catastrophizers using the Pain Catastrophizing Scale (PCS). Their patient profile, and total opioid consumption in the following stages of surgery: intra-operatively, recovery room admission, and the first post-operative day, were recorded and converted to morphine equivalent doses.

Results: The comparative analysis of the morphine equivalent doses between catastrophizers and non-catastrophizers show that it is significantly different between the two groups of patients for opioid consumption for breakthrough pain in the recovery room and on the first post-operative day. The values suggest that there are significantly higher doses in catastrophizers than in the non-catastrophizers.

Conclusion: Pain Catastrophizers were shown to require a significantly higher amount of opioids for breakthrough pain during recovery room admission and first post-operative day versus Non-Catastrophizers. This finding is consistent with the existing literature suggesting that pain catastrophizing is a predictor of post-operative opioid consumption in patients undergoing various elective surgeries.

Keywords: pain catastrophizing, pain perception, opioids

INTRODUCTION

Postoperative pain management continues to be a major challenge to physicians. A study conducted by Gan reported that more than 80% of patients complained of moderate-to- severe postoperative pain. Across facilities, opioids are the most frequently administered analgesic for acute and chronic pain. Despite considerable investment, no new drugs have surpassed opioids as the preeminent analgesics for treating severe pain, particularly in the acute setting.[3] This does not go without consequence as up to 79% of patients receiving opioids experience at least one adverse effect of the drug. The most frequently reported adverse effects being: drowsiness, constipation, and nausea.[1] To this day, postoperative pain is common and remains undertreated, and the distribution and quality of perceived pain has remained largely unchanged.[2]

Pain management guidelines appear to have had little impact on practice patterns or improvement in pain control for patients. Researchers have begun to shift focus to investigating preoperative aspects and psychophysiologic explanations for insufficient pain relief. Type of surgery, age, and psychological distress have been found to be significant predictors for analgesic consumption.[4]

*1st Place, 2023 Philippine Society of Anesthesiologists Inc. Research Forum Contest
[1]from Chong Hua Hospital, Cebu City

Among psychological factors, pain catastrophizing, broadly defined as a tendency to focus excessively on pain and exaggerate its threat value, has increasingly been recognized as a strong psychological predictor of postoperative pain.[5,6] Anesthesiologists may find it helpful and beneficial to target the psychologic aspect of pain and possibly intervene even from the preoperative period. This study aims to identify patients with a catastrophized perception of pain, and to validate the association between preoperative pain perception and postoperative opioid requirement, particularly for the treatment of breakthrough pain.

GENERAL OBJECTIVE

To determine the relationship of pain catastrophizing, as determined by the Pain Catastrophizing Scale (PCS), and postoperative opioid analgesic requirement for breakthrough pain in patients undergoing elective surgical procedures

Specific Objectives

1. To determine the incidence of "Catastrophizers" and "Non-Catastrophizers" with the use of the preoperative Pain Catastrophizing Scale (PCS) in patients undergoing elective surgery.

2. To determine the patient profile of patients stratified as "Catastrophizers" and "Non-Catastrophizers" as to their age, gender, type of surgery, and diagnosis.

3. To determine the total opioid consumption in morphine equivalent doses of patients stratified as "Catastrophizers" and "Non-Catastrophizers" intra- operatively, during recovery room admission (as part of their pain regimen and for breakthrough pain), and the first post-operative day (as part of their pain regimen and for breakthrough pain).

4. To determine the relationship between pre-operative Pain Catastrophizing Scale Scores and the postoperative requirement for opioid analgesia for breakthrough pain.

Definition of Terms

1. Pain Catastrophizing - a psychological perception of pain that refers to the tendency to focus excessively on pain and exaggerate its threat value

2. Pain Catastrophizers - patients who score 30 points or above on the Pain Catastrophizing Scale

3. Non-Catastrophizers - patients who score 29 points or below on the Pain Catastrophizing Scale

4. Pain Regimen - analgesics prescribed to the patient by their attending anesthesiologist that are administered regardless of pain score

5. Breakthrough Pain - severe pain that erupts while the patient is already being medicated with analgesics

LIMITATIONS OF THE STUDY

This study has the following limitations:

Patients with history of previous surgeries already have experience with pain, thereby possibly affecting their PCS score in either a negative or positive way. However, this study is focused on pain management in the acute setting, which is an issue regardless of the presence of previous surgical history. This study will therefore not exclude those subjects who have had previous surgeries, but in order to eliminate other factors that can affect preoperative PCS score, this study will exclude patients who present with pain preoperatively.

Another limitation is that the patients included in the study will be undergoing different surgical procedures, thus there may be a difference in postoperative pain due to differences in size of postoperative site or predicted pain intensity that is unique to each surgical procedure. However, studies have shown that pain catastrophizing affects postoperative pain management regardless of the type of procedure, so it may be beneficial to study the outcomes of patients across different surgical procedures.

A third limitation is that patients receive opioids intra-operatively, within their recovery room admission, and during the first post-operative day, ordered as a pain regimen by their respective attending anesthesiologists. These medications were not withheld in the study population, and therefore may have affected the incidence of breakthrough pain in the subjects. However, in order to partially correct this variable, the total amount of opioids given as pain regimen was also compared across subjects.

REVIEW OF RELATED LITERATURE

Pain is fundamentally a psychophysiological phenomenon that goes beyond mere nociception. Pain, whether linked with tissue injury, inflammation, or functional impairment, is mediated by processing in the nervous system. Yet, regardless of its source, pain may result in hypervigilance, threat appraisals, emotional reactions, and avoidant behavior. In this sense, pain is psychological.[7] Several studies have found that certain psychological factors, such as anxiety, depression, and pain catastrophizing, play a significant role in the development of postoperative pain.[8] Whereas anxiety and depression are more indicative of underlying clinical conditions, pain catastrophizing is a measure of one's tendency to focus excessively on pain and exaggerate its threat value.[6] Currently, patients are being screened with the use of the Pain Catastrophizing Scale (PCS), which is a 13-item instrument wherein patients are asked to indicate the degree to which they have certain thoughts and feelings when they are experiencing pain. [9,10]

A study conducted on the predictive value of pain catastrophizing for pain intensity was done on patients undergoing cardiac surgery, which revealed that there was a strong positive correlation between preoperative PCS score and postoperative pain intensity.[11] This supports the notion that pain catastophizing may have an effect on one's perception of pain postoperatively, across patients who underwent the same procedures. However, all of the subjects in this study were managed postoperatively with the same pain regimen: intravenous morphine infusion and paracetamol boluses. They received subsequent doses of morphine and tramadol for breakthrough pain. The study did not indicate if pain catastrophizers received higher doses of opioids in comparison to non-catastrophizers, and while the study does predict pain intensity, it does not directly correlate with a higher requirement for opioid usage. Another study conducted on patients who underwent total joint arthroplasty controlled for post-operative opioid consumption between catastrophizers and non-catastrophizers.[5] The study actually yielded no statistically significant difference between opioid consumption by catastrophizers compared to non-catastrophizers during their first 2 days postoperatively. However, the data collected showed a positive correlation between catastrophizers and length of hospital stay, as catastrophizers were shown to be twice as likely to require longer than 2 days of stay in the hospital postoperatively, consequently causing these patients to have a higher opioid consumption compared to their counterparts who were discharged earlier. The researchers suggested that catastrophizers may be higher utilizers of hospital resources, perhaps out of fear of inadequate pain control upon hospital discharge. This knowledge supports our hypothesis that pain catastrophizing can lead to higher opioid consumption postoperatively. The study, however, did not indicate whether opioids were used in their facility routinely in patients undergoing total joint arthroplasty, which brings us to the salient issue that opioids, despite their varying well-known major and minor side effects, still play a large role in postoperative pain control.

For decades, physicians have been reliant on opioid analgesics as the mainstay for peri-operative pain management.[12] They have gained popular use because they are highly effective for relieving moderate-to-severe postoperative pain, do not have a ceiling effect and are available in a wide variety of formulations. However, they are not without some serious dose-limiting side effects that range from bothersome to life-threatening, including nausea and vomiting, constipation, oversedation, somnolence and respiratory depression.[2] Opioids bind to u-receptors expressed at key locations within the pain pathway, and their activation suppresses both the reflexive and affective components of pain. However, the respiratory centers in the brainstem, gut, and chemotrigger zone also contain u-receptors. Their activation results in the various side effects one may

experience with opioid use.[3] One retrospective study on patients who underwent surgery within the past 5 years reported that 70% of patients experienced drowsiness, 47% experienced constipation, and 31% experienced nausea during their in-patient stay related to opioid use.[1] Opioids have additional detrimental effects, including tolerance, hyperalgesia, dependence, and addiction. This may lead to the long-term inevitable growth of prescription opioid dispensing, linked to opioid misuse and abuse. [2,13]

On the other hand, recent work has found that patients in some countries frequently receive opioids either unnecessarily or in excess of their requirements for surgical pain control.[15] This could be attributed to the fact that no new drugs have usurped opioids as the preeminent analgesics for treating severe pain. Opioids have now gained popular use as routine postoperative pain management. Furthermore, early postoperative opioid use has been linked as a strong patient risk factor for prolonged opioid use after surgery.[14]

These alarming numbers point that it is logical to look for alternative approaches to treat severe pain. It may be of immeasurable value to place efforts into studying methods that can intervene at a preoperative level. Screening tools that can identify a patient's likelihood to have an increased analgesic requirement allows for anesthesiologists to prepare for an effective multimodal approach to postoperative pain management and to prevent the unnecessary use of harmful analgesics to those who may not require it.

METHODOLOGY

Study Design

The study conducted is a prospective cross-sectional study.

Study Setting

This study was conducted at a tertiary level private institution located in Cebu City.

Study Population

Between January 2021 and June 2021, the researcher approached adult patients, aged 18 and above, admitted and scheduled for elective surgeries and presented with no symptoms of pain preoperatively. This group was selected because the presence of pain preoperatively would affect the outcome of the Pain Catastrophizing Scale. All eligible patients were tracked from the operating room schedule noted on the day prior to the surgery.

Inclusion criteria

a. 18 years of age or older
b. Scheduled for an elective surgery
c. Eligible admitted patients identified from the operating room schedule on the day prior to the surgery

Exclusion criteria

a. Presence of pain preoperatively
b. Patients requiring intensive care admission post-operatively
c. Patients receiving epidural morphine post-operatively

Data Collection

The conduct of the study was implemented upon approval of the protocol by the Institutional Review Board and the Office of the Medical Director, and after obtaining a written informed consent. Patients were stratified preoperatively as "Catastrophizers" or "Non- Catastrophizers" using the Pain Catastrophizing Scale (PCS). Their patient information was collected using the existing Chong Hua Hospital Pre-anesthesia Assessment form. The Pain Catastrophizing Scale involves a 13-item questionnaire wherein patients are asked to indicate the degree to which they have the thoughts and feelings when they are experiencing pain using the 0 (not at all) to 4 (all the time) scale. A total score is yielded (ranging from 0 to 52), and a total of 30 and above represents clinically relevant level of pain catastrophizing.

The following data elements were identified and recorded in each patient: PCS Score, patient profile with regards to age, gender, type of surgery and diagnosis, and opioid use intra-operatively, during recovery room admission, as part of pain regimen and for breakthrough pain, and on the first post-operative day, as part of pain regimen and for breakthrough pain. The total dose of each opioid used was converted to their respective morphine equivalent doses. All data was collected and tallied under total enumeration with a patient data sheet.

Data Analysis

Qualitative data such as patient demographics, and stratification based on the PCS were summarized as frequencies. Multivariate regression analysis was used to examine the relationship between pain catastrophizing and the primary outcome of opioid analgesic use postoperatively.

RESULTS

Table 1. The Incidence of Catastrophizers and Non-Catastrophizers across Subjects, n=32

	Frequency	Percentage
Catastrophizers	7	22%
Non-Catastrophizers	25	78%

The following table (Table 2) shows the demographic and clinical characteristics of the study subjects. Patients have a mean age of 43 years. Thus, in average, they are middle aged persons. The comparative analysis results tell us that the ages are statistically the same between the two groups of patients. The proportions of male and female patients, types of surgery, and diagnoses between the two groups of patients are observed to comparable.

Table 2. The Patient Profile of Subjects, n=32

Characteristics	All Patients n = 32	Patients who are:		P-Value
		Catastrophizer n = 7	Non-Catastrophizer n = 25	
Age, *in mean (SD)*	43.00 (11.32)	44.71 (8.99)	42.52 (12.01)	[A]0.608
Gender				
Male	15 (46.88)	4 (57.14)	11 (44.00)	[B]0.678
Female	17 (53.13)	3 (42.86)	14 (56.00)	
Surgery				
Completion Thyroidectomy	1 (3.13)	0 (0.00)	1 (4.00)	[B]0.630
Excision of Bilateral Breast Masses	1 (3.13)	0 (0.00)	1 (4.00)	
Laparoscopic Cholecystectomy	15 (46.88)	5 (71.43)	10 (40.00)	
Laparoscopic Hernia Repair	2 (6.25)	1 (14.29)	1 (4.00)	
Loop Colostomy	1 (3.13)	0 (0.00)	1 (4.00)	
Modified Radical Mastectomy, Left	1 (3.13)	0 (.00)	1 (4.00)	
Modified Radical Mastectomy, Right	2 (6.25)	0 (0.00)	2 (8.00)	
Open Cholecystectomy	2 (6.25)	1 (14.29)	1 (4.00)	
Simple Mastectomy	1 (3.13)	0 (0.00)	1 (4.00)	
Total Thyroidectomy	6 (18.75)	0 (0.00)	6 (24.00)	

Loop Colostomy	1 (3.13)	0 (0.00)	1 (4.00)	
Modified Radical Mastectomy, Left	1 (3.13)	0 (.00)	1 (4.00)	
Modified Radical Mastectomy, Right	2 (6.25)	0 (0.00)	2 (8.00)	
Open Cholecystectomy	2 (6.25)	1 (14.29)	1 (4.00)	
Simple Mastectomy	1 (3.13)	0 (0.00)	1 (4.00)	
Total Thyroidectomy	6 (18.75)	0 (0.00)	6 (24.00)	
Diagnosis				
Bilateral Breast Masses	1 (3.13)	0 (0.00)	1 (4.00)	[B]0.966
Breast CA, Right	2 (6.25)	0 (0.00)	2 (8.00)	
Breast Mass, Left	1 (3.13)	0 (0.00)	1 (4.00)	
Chronic Calculous Cholecystitis	15 (46.88)	6 (85.71)	9 (36.00)	
Colon Adenocarcinoma	1 (3.13)	0 (0.00)	1 (4.00)	
Follicular Thyroid Carcinoma	1 (3.13)	0 (0.00)	1 (4.00)	
Hurthle Cell Follicular Neoplasm	1 (3.13)	0 (0.00)	1 (4.00)	
Hydrops of the Gallbladder	2 (6.25)	0 (0.00)	2 (8.00)	
Multinodular Non-toxic Goiter	1 (3.13)	0 (0.00)	1 (4.00)	
Multinodular Toxic Goiter	1 (3.13)	0 (0.00)	1 (4.00)	
Non-toxic Goiter	1 (3.13)	0 (0.00)	1 (4.00)	
Papillary Thyroid Carcinoma	2 (6.25)	0 (0.00)	2 (8.00)	
Phyllodes Tumor	1 (3.13)	0 (0.00)	1 (4.00)	
Umbilical Hernia	2 (6.25)	1 (14.29)	1 (4.00)	

Note: Values are presented in Frequency (Proportion) unless otherwise stated; SD means Standard Deviation, *Significant at 0.05 using [A]T-Test for two independent samples and [B]Fisher's Exact test

The following table (Table 3) shows the comparative analysis of the morphine equivalent doses between catastrophizers and non-catastrophizers. The results show that the morphine equivalent doses are significantly different between the two groups of patients in *recovery room – breakthrough* and in *first post-operative day–breakthrough*. The values suggest that there are significantly higher doses in catastrophizers than in the non- catastrophizers.

The morphine equivalent doses in *intra-operative*, in *recovery room – regimen*, and in *first post-operative day - regimen* show no statistically significant difference between the two groups of patients.

Table 3. The Comparative Analysis of the Morphine Equivalent Doses between Catastrophizers and Non-Catastrophizers, n=32

Morphine Equivalent Dose in milligrams	**Patients who are:**		**Test Statistic (P-Value)**
	Catastrophizer n = 7	Non-Catastrophizer n = 25	
Intra-operative	14.36 (2.50)	15.40 (4.49)	-0.80 (0.434)
Recovery Room - Regimen	6.43 (4.76)	3.40 (2.78)	1.61 (0.152)
Recovery Room - Breakthrough	7.14 (3.93)	1.40 (2.71)	3.63 (0.008) *
First post-operative day - Regimen	7.14 (7.56)	2.80 (3.84)	1.47 (0.193)
First post-operative day - Breakthrough	4.29 (1.89)	0.40 (1.38)	5.07 (0.001) *

Note: Values are presented in Mean (Standard Deviation), * Significant at 0.05 using T-Test for two independent samples. All opioids have been converted to their respective morphine equivalent doses before analysis.

DISCUSSION

This study investigates the association between pain catastrophizing and post- operative opioid requirement for breakthrough pain in patients undergoing elective surgery. The results show that there is a positive correlation between patients who were stratified as Catastrophizers and an increased post-operative opioid requirement. The predictive value of pain catastrophizing was independent of intra-operative and regimented opioid use.

The study adds to the literature that suggests that pain catastrophizing can be a good predictor of psychophysiologic factors affecting pain perception and control in surgical patients.[4,6] Some authors have proposed that catastrophizing interrupts the descending pain inhibition signals to the spinal cord, where it favors neuroplastic changes in response to painful stimuli, causing pain sensitization.[11] This may explain why the patients stratified as Catastrophizers utilized significantly higher amounts of opioids for breakthrough pain post- operatively, even if their intra-operative and pre-existing pain regimen opioid analgesia was comparable to their Non-Catastrophizer counterparts.

The results of the present study have the following important clinical implications: first, the findings suggest that using validated measuring instruments, such as the Pain Catastrophizing Scale, allow clinicians to identify patients who are likely to experience more severe post-operative pain and related complications. Secondly, the possibility of designing interventions that aim to intervene at the pre-operative level, considering that pain catastrophizing is a psychophysiologic factor, should be further explored. It's importance in the clinical practice of anesthesiologists is immeasurable, in that it can possibly contribute to decreased incidence of hospital stay, chronic pain, and unsatisfactory patient pain control, ultimately leading to suboptimal post-operative recovery.

CONCLUSION

In this study, the author sought to determine whether pain catastrophizing could be used as a predictor of post-operative opioid requirement for breakthrough pain in patients undergoing elective surgery. Pain Catastrophizers were shown to require a significantly higher amount of opioids for breakthrough pain during recovery room admission and first post-operative day versus Non-Catastrophizers. There was no significant difference between the two groups in total opioid administered intraoperatively, and as part of their pain regimen during recovery room admission and first post-operative day. This finding is consistent with the existing literature suggesting that pain catastrophizing I a predictor of post-operative opioid consumption in patients undergoing various elective surgeries.

RECOMMENDATIONS

The author recommends the use of Pain Catastrophizing Scale in the pre-operative setting to identify patients who are more likely to require greater amounts of opioids for breakthrough pain post-operatively. The early identification of these patients allows anesthesiologists to adequately plan an effective post-operative pain regimen to achieve optimal patient comfort. The author also recommends that further studies be conducted using the Pain Catastrophizing Scale, while including other variables such as emergency and urgent surgery, as well as the use of other analgesic medications such as non-steroidal anti-inflammatory drugs, local anesthetics, and adjunctive epidural analgesia, which is beyond the scope of this study.

REFERENCES

1. Gan T, Habib, A, Miller, T, & White, W. (2013). Incidence, patient satisfaction, and perceptions of post-surgical pain: results from a US national survey. *Current Medical Research & Opinion*, 30(1), 149-160.
2. Rawal, N. (2016). Current Issues in Postoperative Pain Management. *European Journal of Anesthesiology*, 33:160-171.
3. Colvin, L, Bull, F, & Hales, T. (2019). Perioperative opioid analgesia - when is enough too much? A review of opioid-induced tolerance and hyperalgesia. *The Lancet*, 393:1558-68.
4. Ip, H et al. (2009). Predictors of Postoperative Pain and Analgesic Consumption. *Anesthesiology*, 111:657-77.
5. Wright, D et al. (2017). Pain catastrophizing as a predictor for postoperative pain and opiate consumption in total joint arthroplasty patients. *Archives of Orthopaedic and Trauma Surgery*, 137(12):1623-1629.
6. Suso-Ribera, C et al. (2017). Pain Catastrophizing and Its Relationship with Health Outcomes: Does Pain Intensity Matter? *Hindawi Pain and Research Management*, 2017, 1 - 8.
7. Garland, E. (2012). Pain Processing in the Human Nervous System, a selective review of Nociceptive and Behavioral Pathways. *Primary Care*, Sep 39(3): 561-571.
8. Mimic, A et al (2018). Psychological factors as predictors of early postoperative pain after open nephrectomy. *Journal of Pain Research*, 11:955-966.
9. Sullivan, M. (2009). The Pain Catastrophizing Scale User Manual. Montreal: McGill.
10. Pain Catastrophizing Scale. (2017, December 12). Physiopedia. Retrieved 1 March 2020, from https://www.physio-pedia.com/index.php?title=Pain_Catastrophizing_Scale&oldid=181142
11. Khan, R et al (2012). The Association Between Preoperative Pain Catastrophizing and Postoperative Pain Intensity in Cardiac Surgery Patients. *The American Academy of Pain Medicine*, 13(6):820-827.
12. Hollman, M et al. (2019). Optimal postoperative pain management: redefining the role for opioids. *The Lancet*, 393:1483-85.
13. Neuman, M, Bateman, B, & Wunsch, H. (2019). Inappropriate Opioid Prescription After Surgery. *The Lancet*, 393:1547-57.
14. Alam, A et al (2012). Long-term analgesic use after low-risk surgery: a retrospective cohort study. *Archives of Internal Medicine*, 172(5):425-430.
15. Bicket, MC, Long, J, Pronovost PJ. (2017). Prescription opioid analgesics commonly unused after surgery: a systematic review. *JAMA*, 152:1066-71.