Fibromyalgia Survey Criteria Are Associated with Increased Postoperative Opioid Consumption in Women Undergoing Hysterectomy

Allison M. Janda, M.D., Sawsan As-Sanie, M.D., M.P.H., Baskar Rajala, M.D., M.B.B.S., F.R.C.A., Alex Tsodikov, Ph.D., Stephanie E. Moser, Ph.D., Daniel J. Clauw, M.D., Chad M. Brummett, M.D.

ABSTRACT

Background: The current study was designed to test the hypothesis that the fibromyalgia survey criteria would be directly associated with increased opioid consumption after hysterectomy even when accounting for other factors previously described as being predictive for acute postoperative pain.

Methods: Two hundred eight adult patients undergoing hysterectomy between October 2011 and December 2013 were phenotyped preoperatively with the use of validated self-reported questionnaires including the 2011 fibromyalgia survey criteria, measures of pain severity and descriptors, psychological measures, preoperative opioid use, and health information. The primary outcome was the total postoperative opioid consumption converted to oral morphine equivalents.

Results: Higher fibromyalgia survey scores were significantly associated with worse preoperative pain characteristics, including higher pain severity, more neuropathic pain, greater psychological distress, and more preoperative opioid use. In a multivariate linear regression model, the fibromyalgia survey score was independently associated with increased postoperative opioid consumption, with an increase of 7-mg oral morphine equivalents for every 1-point increase on the 31-point measure (Estimate, 7.0; Standard Error, 1.7; $P < 0.0001$). In addition to the fibromyalgia survey score, multivariate analysis showed that more severe medical comorbidity, catastrophizing, laparotomy surgical approach, and preoperative opioid use were also predictive of increased postoperative opioid consumption.

Conclusions: As was previously demonstrated in a total knee and hip arthroplasty cohort, this study demonstrated that increased fibromyalgia survey scores were predictive of postoperative opioid consumption in the posthysterectomy surgical population during their hospital stay. By demonstrating the generalizability in a second surgical cohort, these data suggest that patients with fibromyalgia-like characteristics may require a tailored perioperative analgesic regimen.
(ANESTHESIOLOGY 2015; 122:1103-11)

POSTOPERATIVE pain after hysterectomy is a major issue contributing to patient discomfort, decreased patient satisfaction, risk for postoperative morbidity and mortality, and increasing medical costs due to extended hospital stays.[1,2] It has been estimated that there are 433,621 hysterectomies performed each year in the United States,[3] of which 12 to 17% are done for chronic pelvic pain.[4,5] With a large number of cases performed annually and the possibility of same-day discharge for some patients undergoing hysterectomy, there are economic and patient-safety implications in determining ways to avoid postoperative pain and any factors that lengthen hospital stays. It has been shown in a multicentered, retrospective study that factors predictive of severe acute postoperative pain include younger age, female sex, increased body mass index, preoperative surgical site pain severity, preoperative use of opioids, and general anesthesia.[6] Cognitive factors and pain coping strategies, such as pain catastrophizing, and mood disorders such as depression and anxiety have also been shown to influence acute pain in patients undergoing hysterectomy.[2]

What We Already Know about This Topic

- Higher scores on the survey criteria for fibromyalgia questionnaire have been shown to predict increased opioid consumption after arthroplasty although the generalizability of this has not been tested

What This Article Tells Us That Is New

- In 208 women undergoing hysterectomy, higher scores on a fibromyalgia survey were independently associated with increased opioid consumption after accounting for known risk factors
- This fibromyalgia survey may be useful in identifying individuals at high risk for increased opioid consumption after surgery

This article is featured in "This Month in Anesthesiology," page 1A. Corresponding article on page 967.

Submitted for publication October 29, 2014. Accepted for publication January 30, 2015. From the Department of Anesthesiology, Vanderbilt University Medical Center, Nashville, Tennessee (A.M.J.); Department of Obstetrics and Gynecology, University of Michigan Health System, Ann Arbor, Michigan (S.A.-S.); Department of Anesthesiology, University of Michigan Health System, Ann Arbor, Michigan (B.R., S.E.M., D.J.C., C.M.B.); and Department of Biostatistics, School of Public Health, University of Michigan, Ann Arbor, Michigan (A.T.).

Fibromyalgia is a commonly studied pain disorder, which is associated with aberrant central pain processing.[7–9] Fibromyalgia is associated with higher levels of central nervous system neurotransmitters that facilitate pain and lower levels of those that down-regulate pain.[8,10–12] In addition, fibromyalgia patients have higher endogenous opioids levels with lower opioid receptor availability, which could hypothetically make them less responsive to opioids.[13,14] In 2011, the fibromyalgia survey criteria were described for use *in lieu* of the 1990 criteria, which included a tender point examination.[15,16] Although not intended to be used for diagnosing fibromyalgia without a clinical evaluation, it has been suggested that these criteria can be used in an epidemiological manner.[17] Our group previously demonstrated that the survey criteria for fibromyalgia independently predicted increased opioid consumption after total hip and knee arthroplasty, even when controlling for other predictors such as demographics, preoperative pain intensity, mood, anxiety, catastrophizing, anesthesia type, and surgery.[18]

Whereas higher fibromyalgia survey scores were predictive of increased opioid consumption in arthroplasty,[18] it is not known whether a fibromyalgia-like phenotype would also predict increased opioid consumption in other surgical cohorts, such as patients undergoing hysterectomy. It is important to demonstrate the generalizability of this finding among a separate surgical cohort to increase acceptance of the preoperative fibromyalgia score in clinical decision making. The objective of this prospective, observational cohort study was to assess the impact of the fibromyalgia survey score on acute pain outcomes in subjects undergoing hysterectomy. We hypothesized that higher fibromyalgia survey scores would predict higher postoperative opioid consumption after hysterectomy. Length of stay was studied as a secondary outcome. These data could help to establish preoperative algorithms that personalize pain medicine to the individual patient phenotype rather than using the current care patterns that are dictated primarily by the surgical condition and not tailored based on patient characteristics.

Materials and Methods

Institutional review board (University of Michigan, Ann Arbor, Michigan) approval was obtained. Adult patients (≥18 yr old) scheduled for hysterectomy for a benign indication between October 2011 and December 2013 were prospectively recruited on the day of surgery in the preoperative waiting area. No power analysis was performed when the study was planned. All patients recruited during the period of the study were considered for inclusion subject to the exclusion criteria and availability of the measurements required for the analysis. Exclusion criteria included inability to provide written informed consent, non-English speakers, and prisoners. Written informed consent was obtained from all participants. Study reporting conforms to the STrengthening the Reporting of OBservational studies in Epidemiology Statement.[19]

* UM-CareLink. Available at: http://www.med.umich.edu/carelink/. Accessed February 21, 2014.

Phenotyping Battery

Patients completed preoperative phenotyping using validated self-report measures. The primary measure of interest was the *2011 fibromyalgia survey criteria*.[17] The fibromyalgia survey is composed of the number of painful body areas assessed by using the Michigan Body Map (0 to 19) and comorbid symptoms such as fatigue, trouble thinking, and headaches assessed by using the Symptom Severity Index (0 to 12). Hence, the total fibromyalgia score ranges from 0 to 31. The measure has demonstrated good reliability, convergent validity, and discriminant validity.[20] Previous cut points have been described to categorize a person as "fibromyalgia positive"; however, the continuous score was used for the analyses in the current study. Additional phenotyping included *pain severity* (Brief Pain Inventory; 0 to 10 composite score using the mean of the average, least, worst, and pain right now; overall body pain and surgical site pain assessed separately)[21,22]; neuropathic pain descriptors (PainDETECT),[23] anxiety and depression (Hospital Anxiety and Depression Scale),[24] and catastrophizing (Coping Strategies Questionnaire).[25,26] The medication list from the preoperative records was printed and reviewed with the patient by a research assistant. All medications administered as needed were reviewed in detail to ensure the ability to differentiate the varied patterns of opioid use (*e.g.*, differentiating patient who uses one hydrocodone per week from the person who takes three daily). The average daily opioid consumption was converted to a 24-h oral morphine equivalent (OME) total.[27,28] Opioids administered by the anesthesia team before and during surgery were also converted to OMEs as a covariate. Demographics, body mass index, and American Society of Anesthesiologists (ASA) physical status score were collected from the electronic medical record (Centricity; General Electric Healthcare, USA). Because all patients received general anesthesia, the anesthetic technique was not assessed. The surgical approach was recorded as vaginal, laparoscopic, robotic, or open.

Acute Pain Outcomes Assessment

The total postoperative opioid consumption (primary outcome) was obtained from the institutional electronic order entry system (Carelink*) and nursing records throughout time in the postanesthesia care unit and the inpatient course, as previously described by Brummett *et al.*[18] Opioid use in the postanesthesia care unit was assessed separately and included in the total postoperative opioid consumption (combined with opioids administered after the postanesthesia care unit). All opioid data (preoperative, intraoperative, and postoperative) were converted to morphine equivalents (OME) for analyses. The length of stay was included as a covariate for postoperative opioid consumption to account for differences in opioids that were merely due to longer inpatient stays.

The cohort was also prospectively followed longitudinally for 6 months for chronic pain outcomes, which are

not included in the current article. The opioid consumption data represent the primary outcome analysis for the acute pain portion of this prospective, observational cohort study.

Statistical Analysis

Data were entered into the Assessment of Pain Outcomes Longitudinal Electronic Data Capture system.[29] Missing data for the validated instruments were handled as recommended by instrument authors,[23,30,31] and further described in a previous publication.[18] Other missing data were handled as described by the authors of each individual instrument.[23,30,31] For the Brief Pain Inventory and PainDETECT tools, if patients were missing more than one item, the subject was excluded. For the Hospital Anxiety and Depression Scale, anxiety and depressive symptom scores, a single value for the missing item was inferred by imputation of the mean if six of the seven values were present. For all other tools, one missing question was allowed. Patients were not excluded for having one incomplete questionnaire.

Data were analyzed by using R 3.1.1 and SPSS (version 19; SPSS Inc., USA).

The cohort was divided into tertiles based on the estimates of 1/3 and 2/3 percentiles of the distribution of the fibromyalgia survey score for descriptive data and univariate outcomes analyses. Mean and SDs are presented for preoperative covariates. Between-groups comparisons were based on univariate models specific to the scale of the variable being considered (linear regression with continuous data, logistic with binary data). Histograms and Q–Q plots were examined to assess normality. Nonparametric analysis of the overall differences by group was performed by using the Kruskal–Wallis test. Bonferroni adjustment for multicomparisons was used in reporting the statistical significance of test results.

Total postoperative opioid consumption throughout the entire postoperative course was converted into OMEs for outcomes analyses. Multivariate linear regression models were used to analyze postoperative opioid consumption. All preoperative covariates, as well as intraoperative opioid administration and length of stay, were included as covariates in the multivariate modeling. Model-based hypotheses testing and a search for the best parsimonious model (variable selection) were performed using likelihood ratio tests and the Bayesian Information Criterion (BIC). BIC is preferred in the theory-based approach as it provides consistent estimates of the true model. Furthermore, a 10-fold cross-validation procedure was conducted to provide an assessment of model's performance in future observations and predict shrinkage effects when the model is applied out-of-sample. The variable selection procedure was included in the cross-validation loop and was done anew for each training subset of the data. Models were conducted with missing data on relevant data excluded. Backward search for the best model was conducted starting from all variables included in the initial full model and supervised by medical experts within the limits of uncertainty allowed by the technical procedure. Interactions were tested by the likelihood ratio tests. Two-sided tests and 0.05 significance levels were used throughout.

Results

Subject Participation and Demographics

A total of 208 patients of the 307 patients approached agreed to participate (68% participation rate). In analysis of participants *versus* nonparticipants, there were significant differences for age (participants 47.6 yr *vs.* nonparticipants 50.4 yr; $P = 0.033$) and race (84.6 *vs.* 66.7% Caucasian; $P < 0.0001$). One patient withdrew on the day of surgery, one patient was excluded from analysis due to additional surgeries during the same admission, and three patients were excluded because they did not undergo the planned hysterectomy and instead underwent a different procedure as outlined in the flowchart (fig. 1). Regarding missing data, eight patients of the 203 analyzed were missing data for the fibromyalgia survey score and were not included in the analysis. Data from 195 patients were analyzed.

Preoperative Phenotype and Outcomes by Tertile of Fibromyalgia Survey Score

A histogram of fibromyalgia scores is shown in figure 2. The mean fibromyalgia score for the entire cohort was 6.5 (±4.4) with a range of 0 to 24. A total of 17 patients (8.2%) met the previously described cut points of being termed "fibromyalgia positive."[17] The subjects were divided into tertiles based on fibromyalgia survey score (low, 0 to 4, n = 68; moderate, 5 to 7, n = 59; and high, 8 to 24, n = 68). As shown in table 1, there were no significant differences in age, race, body mass index, surgical approach, or ASA physical status score between fibromyalgia score tertiles. In addition, there were differences in surgical site body pain, overall body pain, depressive symptoms, anxiety, and catastrophizing between all groups ($P < 0.0001$ for all listed). Patients in the high fibromyalgia group were taking more daily opioids preoperatively and were on a higher average opioid dose (OME) when compared with the low and moderate groups ($P < 0.01$ for each comparison).

There was an increase in postoperative opioid consumption between low *versus* high fibromyalgia score groups ($P = 0.013$) as seen in table 2. Figure 3 demonstrates the scatterplot of total postoperative opioid consumption and the fibromyalgia survey score. Length of stay was not significantly different between groups (table 2).

Fibromyalgia Survey Score Independently Associated with Postoperative Opioid Consumption

The primary outcome, postoperative opioid consumption, was positively associated with the continuous fibromyalgia survey score in the multivariate linear regression model ($P < 0.0001$). Multivariate analysis also showed that higher ASA physical status score, catastrophizing, laparotomy surgical approach, and preoperative opioid consumption were

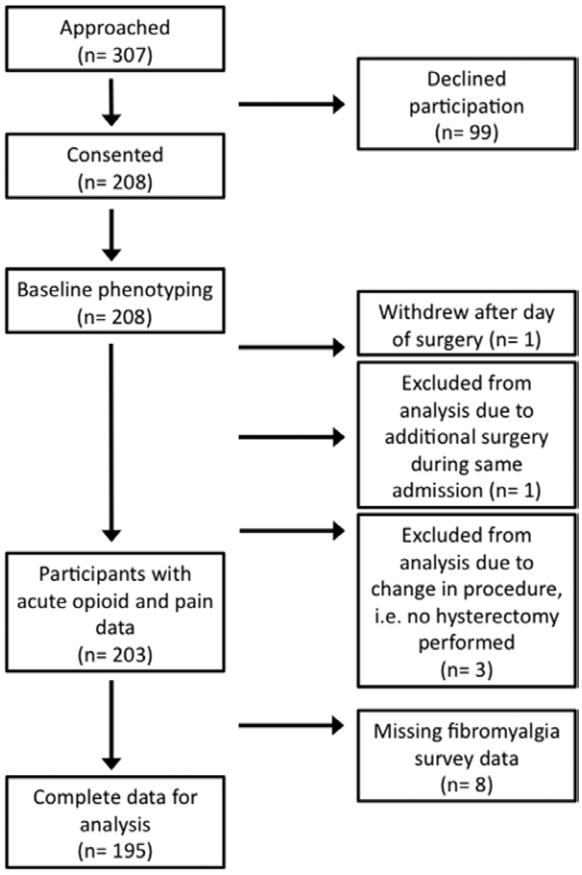


Fig. 1. Flow diagram of patient recruitment.

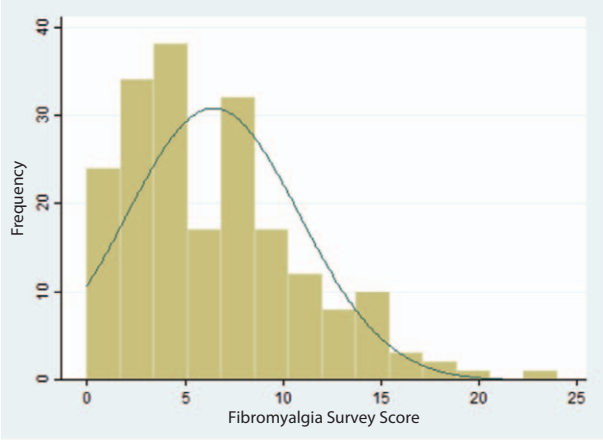


Fig. 2. Fibromyalgia survey scores. The fibromyalgia survey score comprises a measure of widespread body pain (0–19) and an assessment of comorbid symptoms (0–12) for a total possible score of 0–31. The histogram displays the fibromyalgia survey scores of the study participants.

all predictive of increased postoperative opioid consumption (table 3). Backward variable selection using likelihood ratio tests and the BIC-based model selection procedure resulted in one and the same best model with BIC = 2,231 presented in table 3. Over the set of cross-validation runs, the best variables presented in table 3 were selected 80 to 100% of the time, whereas selection frequency of other variables did not exceed 10%. Shrinkage from the raw R^2 of 0.53 based on the best model to the cross-validated R^2 of 0.35 was observed. The linear regressions with the log-transformed response were also considered. However, there was no improvement in fit as judged by the plots of residuals. The results of modeling without the transformation were confirmed, and the fibromyalgia survey score still was statistically significantly correlated with postoperative opioid use (data not shown).

Discussion

The Fibromyalgia Survey Score Predicts Increased Postoperative Opioid Use

This study demonstrated that increased fibromyalgia survey scores are predictive of increased postoperative opioid use after hysterectomy. These data support the findings by Brummett *et al.*,[18] which showed this survey score as independently associated with increased postoperative opioid consumption in total hip and knee arthroplasty cohorts, and support the fact that the fibromyalgia survey score is more broadly useful in predicting opioid consumption after surgery. Each 1-point increase on the 31-point fibromyalgia survey score was associated with an adjusted increase of almost 7-mg oral morphine in the postoperative inpatient period (table 3), which is close to the estimated 9 mg OME increase in the total knee and hip arthroplasty cohort.

The use of the fibromyalgia survey criteria in a surgical cohort represents a relatively novel approach to predicting postoperative pain and opioid consumption. It is important to stress that this is not a cohort of fibromyalgia patients. Instead, the current study assessed the spectrum of signs and symptoms associated with fibromyalgia as a means to place patients on a continuum of sensitivity. Based on that which is known about fibromyalgia,[9] our group believes that patients higher on this measure represent a population with pain that is more "centralized" in nature (*e.g.*, altered central nervous system pain processing). Not surprisingly, the fibromyalgia survey scores in this cohort are much lower than a pure fibromyalgia cohort. In the 2011 survey criteria for fibromyalgia, patients were classified as "fibromyalgia positive" if their scores were widespread body pain 7 or greater (score ranges 0 to 19, body map assessment) and symptom severity index 5 or greater (score range 0 to 12) or widespread pain index of 3 to 6 and symptom severity index 9 or greater.[17] More simply, a total score of 13 or greater has also been termed positive for fibromyalgia. The validity of the survey criteria in a fibromyalgia cohort when compared with the 1990 American College of Rheumatology criteria (which included the tender point examination) has been established.[32,33] Preoperative diagnoses of fibromyalgia were not assessed, as the diagnosis can be influenced by patients' access to health care and the treating physician. Whether the strength of these relations would be stronger in a "pure" fibromyalgia cohort is challenging to estimate.

Table 1. Preoperative Pain Phenotype Based on Fibromyalgia Survey Score Divided into Low, Medium, and High Scores

	Low FM	Moderate FM	High FM				
	FM Score 0–4	FM Score 5–7	FM Score 8–24	*P* Value (Regression for Overall Group)	*P* Value (Low FM *vs.* Moderate FM)	*P* Value (Low FM *vs.* High FM)	*P* Value (Moderate FM *vs.* High FM)
	n = 68	n = 59	n = 68				
Demographics							
Age (yr)	49.6 (10.71)	46.27 (8.12)	45.76 (10.15)	0.050	0.057	0.023	0.772
Race (% Caucasian)	83.8	89.8	85.3	0.600	0.321	0.812	0.442
Preoperative pain, affect, function							
Surgical site body pain†	0.51 (1.48)	1.60 (2.10)	2.47 (2.75)	<0.0001	0.005*	<0.0001*	0.025
Overall body pain	1.19 (1.71)	2.06 (1.77)	3.84 (2.24)	<0.0001	0.012*	<0.0001*	<0.0001*
Depressive symptoms†	2.12 (2.58)	3.21 (3.11)	6.09 (3.63)	<0.0001	0.058	<0.0001*	<0.0001*
Anxiety	5.2 (4.13)	6.75 (3.73)	8.43 (4.16)	<0.0001	0.036	<0.0001*	0.022
Catastrophizing†	2.52 (4.01)	3.91 (4.89)	7.20 (6.19)	<0.0001	0.144	<0.0001*	0.001*
Preoperative opioids (% taking opioids)	8.82	8.47	23.53	0.016	0.944	0.020	0.023
Preoperative opioid average daily dose (OME, mg)†	0.628 (2.66)	0.838 (3.72)	5.67 (17.15)	0.008	0.910	0.005*	0.010*
Medical, anesthetic, and surgical variables							
Body mass index (kg/m^2)	28.52 (6.41)	30.22 (6.33)	29.98 (7.19)	0.288	0.153	0.203	0.840
ASA status (% per group)							
ASA score 1 and 2	95.6	89.8	83.8	0.143	0.30	0.050	0.321
ASA score 3 and 4	4.4	10.2	16.2				
Surgical approach (%)							
Traditional laparoscopy	25.0	35.6	41.2	0.249	0.592	0.087	0.237
Robotic (Davinci)	26.5	20.3	27.9				
Laparotomy	13.2	13.6	4.4				
Vaginal and LAVH	35.3	30.5	26.5				

Patients in the high fibromyalgia survey score group had significantly worse preoperative pain characteristics, including higher pain severity, more neuropathic pain, greater psychological distress, and more preoperative opioid use compared with the low fibromyalgia score group. Data presented as mean (SD) if continuous, or proportions (%) if categorical. Statistics and *P* values are regression model based with fibromyalgia tertile group as a categorical covariate. Model is linear for continuous response and logistic for binary. First *P* value represents the overall regression result, and the individual between group comparisons are noted in the *P* values to follow. Unadjusted *P* values are presented. Statistical significance for overall regression results set at the level of $P < 0.05$.

* Significant comparisons for *post hoc* analyses using Bonferroni-corrected α of 0.016. † Variable is not normally distributed. Nonparametric analyses conducted for nonnormally distributed data using the Kruskal–Wallis test. Results relatively unchanged in nonparametric approaches (nonparametric data not shown).

ASA score = American Society of Anesthesiologists physical status score; FM = fibromyalgia survey score; LAVH = Laparoscopic-assisted vaginal hysterectomy; OME = oral morphine equivalents measured in milligram.

Table 2. Postoperative Opioid Consumption and Length of Stay Outcomes by Tertile of Fibromyalgia Survey Scores

	Low FM	Moderate FM	High FM				
	FM Score 0–4	FM Score 5–7	FM Score 8–24	*P* Value (Regression for Overall Group)	*P* Value (Low FM *vs.* Moderate FM)	*P* Value (Low FM *vs.* High FM)	*P* Value (Moderate FM *vs.* High FM)
	n = 68	n = 59	n = 68				
Total postoperative opioid consumption (OME, mg)	72.3 (80.3)	79 (76.0)	93 (79.7)	0.019	1.000	0.013*	0.018
Length of stay (h)	28.30 (14.25)	26.62 (16.05)	29.66 (23.46)	0.652	0.610	0.667	0.356

Univariate analyses demonstrated higher total postoperative opioid consumption in the high *vs.* the low groups. Patients in the high fibromyalgia score group did not have a significantly longer inpatient course compared with patients in the low group. Data presented as median (IQR) for total postoperative OME (mg) and mean (SD) for length of stay. Statistics and *P* values are regression model based with fibromyalgia tertile group as a categorical covariate for length of stay. Nonparametric Kruskal–Wallis test *P* values are presented for total postoperative OME (mg). The first *P* value represents the overall regression result, and the individual between-group comparisons are noted in the *P* values to follow. Unadjusted *P* values are presented.

* Statistically significant result. For *post hoc* between-group analyses, a Bonferroni correction was applied (α of 0.016).

FM = fibromyalgia survey score; OME = oral morphine equivalents measured in milligram.

Whereas only 8.2% of this cohort met these criteria of being termed "fibromyalgia positive," the associations between the increased fibromyalgia score and opioid consumption were demonstrated across the continuum of scores in the multivariate modeling (table 3). These data further underscore the importance of assessing patients who are sometimes termed "subclinical" or "subthreshold," as the defined cut points fail to account for the middle of the distribution. Our group is interested in larger studies of a broader group of surgical cohorts to try to consider thresholds above which patients tend to require more opioids or have differential perioperative outcomes. In clinical care, it is more likely that higher scores on the measure would trigger deeper phenotyping and assessment to consider appropriateness of alternative acute pain treatments, whereas patients lower on the measure could get a more typical perioperative algorithm.[34]

Fibromyalgia from a Physiologic Perspective

It has been shown that patients with fibromyalgia have lower μ-receptor availability,[14] and higher endogenous opioid levels (cerebrospinal fluid levels),[13] compared with those without fibromyalgia. A study by Bruehl *et al.*[35] found that individuals with preexisting high endogenous opioid function had a smaller benefit from morphine administration than those with lower opioid function, with individual differences in endogenous opioids accounting for 29% of the variance in responsiveness to opioids in the acute setting. The degree of endogenous opioid function was determined by finding the difference between pain values after administration of placebo and administration of naloxone, an opioid receptor antagonist.[36] This same group investigated chronic pain as well and found that those with lower natural opioid levels had better acute relief from morphine in the treatment of chronic back pain than those patients found to have higher endogenous opioid levels.[35]

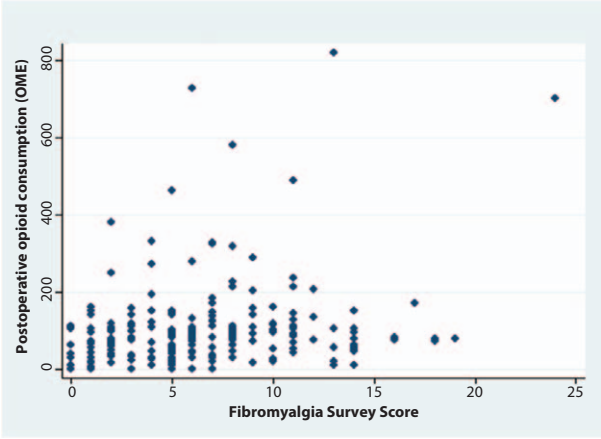


Fig. 3. Scatterplot of opioid consumption and the fibromyalgia survey score. The figure shows the scatterplot of the preoperative fibromyalgia survey score (measure ranges from 0 to 31) and total inpatient postoperative opioid consumption in oral morphine equivalents (OME).

These physiologic findings may have great clinical significance in guiding how clinicians treat pain in this population of patients. It has long been believed that opioids are less effective in fibromyalgia patients due to these known central nervous system physiologic abnormalities.[9] In this study, we attempted to capture these biological differences at a phenotypic level through the fibromyalgia survey score. The identification of this patient population exhibiting fibromyalgia-like symptoms, paired with data showing that this group of patients has a decreased response to opioid medications, may allow clinicians to use a simple phenotypic battery to practice personalized pain medicine. The fibromyalgia survey score may serve as a biomarker for an individual's endogenous opioid tone and may therefore predict their response to exogenous opioids. Future studies including imaging and prospective follow-up are needed to better elucidate the clinical applicability of the findings.

Clinical Applicability of the Fibromyalgia Survey Score

Validation of the fibromyalgia survey score in a second surgical cohort increases the clinical applicability of this scoring system in practice. The importance of demonstrating generalizability of predictive modeling was described in a recent editorial by Drs. Eisenach and Houle.[37] This survey is an easily

Table 3. Best-fit Linear Regression of the Multivariate Analysis of Postoperative Opioid Consumption

Variable	Estimate	Standard Error	*P* Value
Intercept	65.063	13.017	<0.0001
Fibromyalgia survey score	6.952	1.662	<0.0001
ASA class 3 or 4	–48.489	21.397	0.02
Brief Pain Inventory severity	–10.063	3.261	0.002
Anxiety (HADS)	–5.427	1.726	0.002
Catastrophizing	4.464	1.460	0.003
Surgical approach of laparotomy	197.949	20.385	<0.0001
Preoperative opioids (OME, mg)	5.491	0.627	<0.0001

The fibromyalgia survey score was independently associated with an increased postoperative opioid consumption, with an increase of 7-mg oral morphine equivalents for every 1-point increase on the 31-point measure. In addition to the fibromyalgia survey score, multivariate analysis showed that higher ASA class, catastrophizing, laparotomy surgical approach, and preoperative opioid use were also predictive of increased postoperative opioid consumption (R^2 = 0.534). Multivariate analysis was performed with total inpatient postoperative opioid consumption (converted to OME) as the dependent measure and the best linear regression model is shown above. Estimates and standard error are listed.

ASA class = American Society of Anesthesiologists physical status classification system; HADS = Hospital Anxiety and Depression Scale; OME = oral morphine equivalents measured in milligram.

administered tool that can better prepare providers for the postoperative course of a patient at the individual level allowing for a personalized care plan. It is possible that patients with higher fibromyalgia survey scores would receive substantial benefit from regional analgesia and/or adjunct pharmacological therapies (*e.g.*, serotonin–norepinephrine reuptake inhibitors, gabapentinoids). This one-page survey would be a simple and clinically relevant tool to administer before surgery to aid in development of the anesthetic and pain management plan. Although the measure does a good job of distinguishing patients with worse preoperative phenotypes and independently predicts increased opioid consumption, there are patients higher on the measure that do well (fig. 3). It is possible that additional domains of pain and affect need to be included to increase the predictive value of the measure. Our group is currently exploring these concepts.

It is also possible that patients who are more fibromyalgia-like would benefit from adjunctive medications that go beyond the acute, inpatient period to further address subacute pain after hospital discharge. Aiding surgeons in the identification of patients prone to more severe acute pain and creating individualized care plans is an opportunity for anesthesiologists to add value in the Perioperative Surgical Home model.†

Additional Predictors of Postoperative Opioid Use

Additional predictors of increased postoperative opioid consumption include higher ASA class, catastrophizing, laparotomy surgical approach, and preoperative opioid use. The laparotomy surgical approach being a predictor of increased opioid consumption is clinically relevant to obstetricians and gynecologists in their surgical decision making for each patient. Because this surgical approach is predictive of increased opioid use, providers should attempt to use alternative surgical approaches unless otherwise contraindicated.

† ASA Newsletter, June 2014, Volume 78(6). Available at: https://www.asahq.org/resources/publications/newsletter-articles/2014/june-2014/implementing-a-perioperative-surgical-home-start-with-why-and-then-start. Accessed March 10, 2015.

Limitations

This study is limited in that it is a single-center study and therefore is limited by our institutional guidelines, patient population, and surgeon preferences and techniques. Further studies with multiple centers would add generalizability of the fibromyalgia survey criteria and its clinical application. In this study, we used postoperative OME consumption as a proxy variable for postoperative pain, and we were unable to collect individual pain scores for each patient due to inconsistent recording in the patient record. Opioid consumption is not likely a perfect proxy for the severity of pain. In the future, we plan to prospectively collect pain score data.

Conclusions

As was previously demonstrated in a total knee and hip arthroplasty cohort,[18] this study demonstrated that increased fibromyalgia survey scores were predictive of postoperative opioid consumption in the posthysterectomy surgical population during their hospital stay. This finding reiterates that the fibromyalgia survey score is an important clinical tool that can be used to detect phenotypic differences in patients with centralized pain syndromes, such as fibromyalgia, and better treat pain in the postoperative period.

Acknowledgments

The authors thank Sachin Kheterpal, M.D., M.B.A., and Tyler Tremper, B.S.E. (both from the Department of Anesthesiology, University of Michigan, Ann Arbor, Michigan), for assistance with the electronic medical record query. The authors also thank Deborah Wagner, Pharm.D., F.A.S.H.P. (Department of Anesthesiology and the School of Pharmacy, University of Michigan), for assistance in opioid conversions.

Supported by the Department of Anesthesiology, University of Michigan, Ann Arbor, Michigan. Research funding was received from Neuros Medical Inc. (Willoughby Hills, Ohio) (to Dr. Brummett) and from Eli Lilly (Indianapolis, Indiana), Merck Pharmaceuticals (Whitehouse Station, New Jersey), and Forest Pharmaceuticals (New York, New York) (to Dr. Clauw).

Competing Interests

Dr. Clauw is a consultant for Pfizer, Inc. (New York, New York), Johnson and Johnson (New Brunswick, New Jersey), Forest Pharmaceuticals (New York, New York), Merck (Whitehouse Station, New Jersey), Nuvo Research, Inc. (Mississauga, Ontario, Canada), Eli Lilly, Inc. (Indianapolis, Indiana), Grunenthal Pharma Ltd. (Dublin, Ireland), Jazz Pharmaceuticals, Inc. (Palo Alto, California), and Purdue Pharma (Stamford, Connecticut). The other authors declare no competing interests.

Correspondence

Address correspondence to Dr. Brummett: Department of Anesthesiology, Division of Pain Medicine, University of Michigan Health System, 1500 East Medical Center Drive, 1H247 UH, Box 5048, Ann Arbor, Michigan 48109. cbrummet@umich.edu. This article may be accessed for personal use at no charge through the Journal Web site, www.anesthesiology.org.

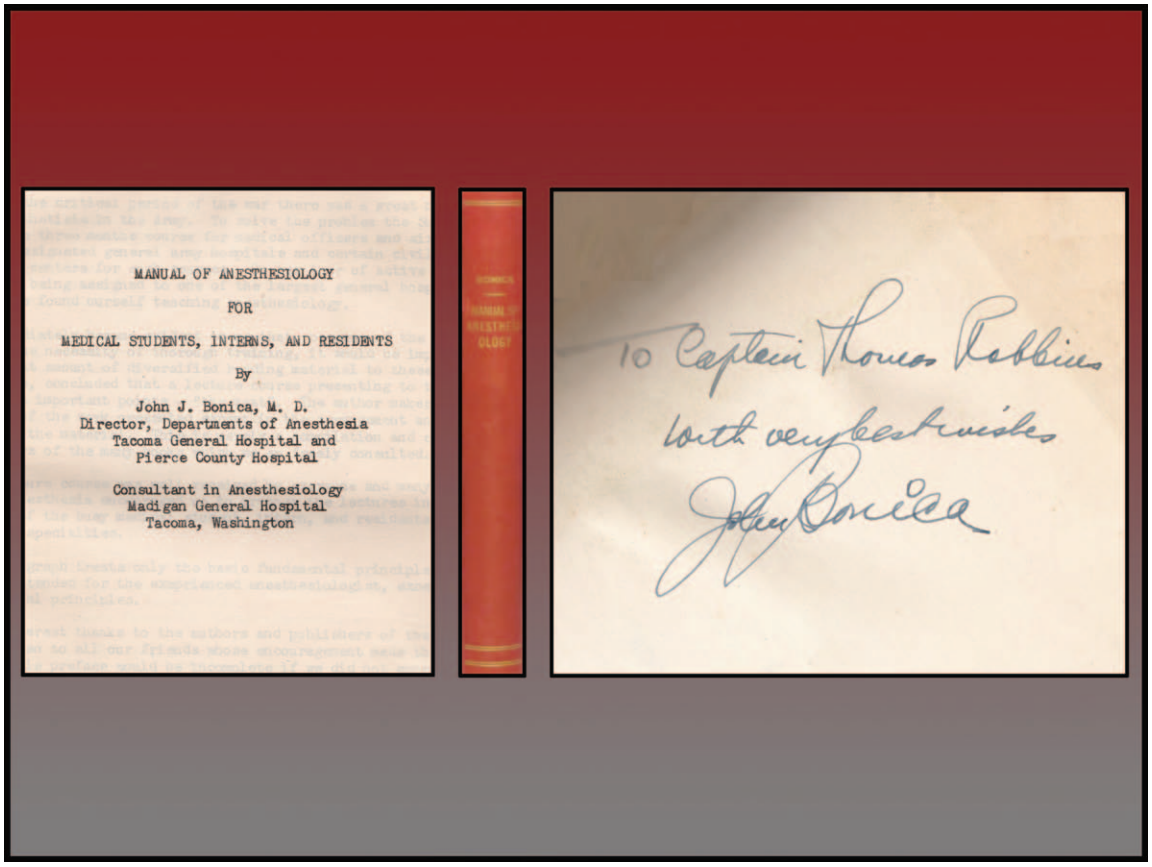
References

1. Schiavone MB, Herzog TJ, Ananth CV, Wilde ET, Lewin SN, Burke WM, Lu YS, Neugut AI, Hershman DL, Wright JD: Feasibility and economic impact of same-day discharge for women who undergo laparoscopic hysterectomy. Am J Obstet Gynecol 2012; 207:382.e1–9
2. Pinto PR, McIntyre T, Almeida A, Araújo-Soares V: The mediating role of pain catastrophizing in the relationship between presurgical anxiety and acute postsurgical pain after hysterectomy. Pain 2012; 153:218–26
3. Wright JD, Herzog TJ, Tsui J, Ananth CV, Lewin SN, Lu YS, Neugut AI, Hershman DL: Nationwide trends in the performance of inpatient hysterectomy in the United States. Obstet Gynecol 2013; 122(2 Pt 1):233–41
4. Howard FM: The role of laparoscopy in chronic pelvic pain: Promise and pitfalls. Obstet Gynecol Surv 1993; 48:357–87
5. Whiteman MK, Hillis SD, Jamieson DJ, Morrow B, Podgornik MN, Brett KM, Marchbanks PA: Inpatient hysterectomy surveillance in the United States, 2000–2004. Am J Obstet Gynecol 2008; 198:34.e1–7
6. Ip HY, Abrishami A, Peng PW, Wong J, Chung F: Predictors of postoperative pain and analgesic consumption: A qualitative systematic review. Anesthesiology 2009; 111:657–77
7. Brummett CM, Clauw DJ: Fibromyalgia: A primer for the anesthesia community. Curr Opin Anaesthesiol 2011; 24:532–9
8. Williams DA, Clauw DJ: Understanding fibromyalgia: Lessons from the broader pain research community. J Pain 2009; 10:777–91
9. Clauw DJ: Fibromyalgia: A clinical review. JAMA 2014; 311:1547–55
10. El-Gabalawy H, Ryner L: Central nervous system abnormalities in fibromyalgia: Assessment using proton magnetic resonance spectroscopy. J Rheumatol 2008; 35:1242–4
11. Harris RE, Sundgren PC, Craig AD, Kirshenbaum E, Sen A, Napadow V, Clauw DJ: Elevated insular glutamate in fibromyalgia is associated with experimental pain. Arthritis Rheum 2009; 60:3146–52
12. Foerster BR, Petrou M, Edden RA, Sundgren PC, Schmidt-Wilcke T, Lowe SE, Harte SE, Clauw DJ, Harris RE: Reduced insular γ-aminobutyric acid in fibromyalgia. Arthritis Rheum 2012; 64:579–83
13. Baraniuk JN, Whalen G, Cunningham J, Clauw DJ: Cerebrospinal fluid levels of opioid peptides in fibromyalgia and chronic low back pain. BMC Musculoskelet Disord 2004; 5:48
14. Harris RE, Clauw DJ, Scott DJ, McLean SA, Gracely RH, Zubieta JK: Decreased central mu-opioid receptor availability in fibromyalgia. J Neurosci 2007; 27:10000–6
15. Wolfe F, Häuser W, Hassett AL, Katz RS, Walitt BT: The development of fibromyalgia–I: Examination of rates and predictors in patients with rheumatoid arthritis (RA). Pain 2011; 152:291–9
16. Wolfe F, Smythe HA, Yunus MB, Bennett RM, Bombardier C, Goldenberg DL, Tugwell P, Campbell SM, Abeles M, Clark P: The American College of Rheumatology 1990 criteria for the classification of fibromyalgia. Report of the Multicenter Criteria Committee. Arthritis Rheum 1990; 33:160–72
17. Wolfe F, Clauw DJ, Fitzcharles MA, Goldenberg DL, Häuser W, Katz RS, Mease P, Russell AS, Russell IJ, Winfield JB: Fibromyalgia criteria and severity scales for clinical and epidemiological studies: A modification of the ACR Preliminary Diagnostic Criteria for Fibromyalgia. J Rheumatol 2011; 38:1113–22
18. Brummett CM, Janda AM, Schueller CM, Tsodikov A, Morris M, Williams DA, Clauw DJ: Survey criteria for fibromyalgia independently predict increased postoperative opioid consumption after lower-extremity joint arthroplasty: A prospective, observational cohort study. Anesthesiology 2013; 119:1434–43
19. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative: The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. J Clin Epidemiol 2008; 61:344–9
20. Häuser W, Jung E, Erbslöh-Möller B, Gesmann M, Kühn-Becker H, Petermann F, Langhorst J, Weiss T, Winkelmann A, Wolfe F: Validation of the Fibromyalgia Survey Questionnaire within a cross-sectional survey. PLoS One 2012; 7:e37504
21. Tan G, Jensen MP, Thornby JI, Shanti BF: Validation of the Brief Pain Inventory for chronic nonmalignant pain. J Pain 2004; 5:133–7
22. Jensen MP, Turner JA, Romano JM, Fisher LD: Comparative reliability and validity of chronic pain intensity measures. Pain 1999; 83:157–62
23. Freynhagen R, Baron R, Gockel U, Tölle TR: painDETECT: A new screening questionnaire to identify neuropathic components in patients with back pain. Curr Med Res Opin 2006; 22:1911–20
24. Hassett AL, Brummett CM, Goesling J, Rakovitis K, Clauw DJ, Williams DA: The Hospital Anxiety and Depression Scale (HADS) Positive Affect Subscale: A preliminary evaluation of its utility for the assessment of resilience in fibromyalgia. Arthritis Rheum 2011; 63:S942
25. Rosenstiel AK, Keefe FJ: The use of coping strategies in chronic low back pain patients: Relationship to patient characteristics and current adjustment. Pain 1983; 17:33–44
26. Swartzman LC, Gwadry FG, Shapiro AP, Teasell RW: The factor structure of the Coping Strategies Questionnaire. Pain 1994; 57:311–6
27. McMaffery M, Pasero C (eds.): Pain: Clinical Manual, 2nd edition. St. Louis, Mosby, Inc., 1999, pp 206–9, 241–2
28. Wilcock A, Charlesworth S, Dickman A: Analgesics. In Twycross R (ed.), Palliative Care Formulary, 2nd edition. Abingdon, United Kingdom, Radcliffe Medical Press Ltd., 2003, chapter 9
29. Hassett AL, Wasserman R, Goesling J, Rakovitis K, Shi B, Brummett CM: Longitudinal assessment of pain outcomes in the clinical setting: Development of the "APOLO" electronic data capture system. Reg Anesth Pain Med 2012; 37:398–402
30. Keller S, Bann CM, Dodd SL, Schein J, Mendoza TR, Cleeland CS: Validity of the Brief Pain Inventory for use in documenting the outcomes of patients with noncancer pain. Clin J Pain 2004; 20:309–18
31. Zigmond AS, Snaith RP: The hospital anxiety and depression scale. Acta Psychiatr Scand 1983; 67:361–70
32. Wolfe F, Clauw DJ, Fitzcharles MA, Goldenberg DL, Katz RS, Mease P, Russell AS, Russell IJ, Winfield JB, Yunus MB: The American College of Rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. Arthritis Care Res (Hoboken) 2010; 62:600–10

33. Vincent A, Brimmer DJ, Whipple MO, Jones JF, Boneva R, Lahr BD, Maloney E, St Sauver JL, Reeves WC: Prevalence, incidence, and classification of chronic fatigue syndrome in Olmsted County, Minnesota, as estimated using the Rochester Epidemiology Project. Mayo Clin Proc 2012; 87:1145–52
34. Brummett CM, Clauw DJ: Flipping the Paradigm: From surgery-specific to patient-driven perioperative analgesic algorithms. ANESTHESIOLOGY 2015; (in press)
35. Bruehl S, Burns JW, Gupta R, Buvanendran A, Chont M, Schuster E, France CR: Endogenous opioid inhibition of chronic low-back pain influences degree of back pain relief after morphine administration. Reg Anesth Pain Med 2014; 39:120–5
36. Bruehl S, Burns JW, Gupta R, Buvanendran A, Chont M, Kinner E, Schuster E, Passik S, France CR: Endogenous opioid function mediates the association between laboratory-evoked pain sensitivity and morphine analgesic responses. Pain 2013; 154:1856–64
37. Eisenach JC, Houle TT: Replication to advance science: Changes in ANESTHESIOLOGY. ANESTHESIOLOGY 2014; 121:209–11

ANESTHESIOLOGY REFLECTIONS FROM THE WOOD LIBRARY-MUSEUM

John Bonica's Presentation Copy to Capt. Thomas Robbins



Before chairing the Department of Anesthesiology in 1960 at the University of Washington, Dr. John J. Bonica directed "Departments of Anesthesia" at Tacoma General Hospital and Pierce County Hospital. For trainees at those facilities, Dr. Bonica bound (*left* and *middle*) typewritten pages into a red volume titled *Manual of Anesthesiology for Medical Students, Interns, and Residents*. Anesthesia mentor Bonica presented this manual "with very best wishes" (*right*) to a Captain Thomas Robbins. After I won this presentation volume on an internet auction, I decided to donate this "manual" to the Wood Library-Museum in memory of another Bonica disciple, Richard G. Black, M.D., who mentored me patiently for 6 months on pain management and regional anesthesia for the elderly, during my Hopkins–National Institutes of Health fellowship in geriatric anesthesiology. (Copyright © the American Society of Anesthesiologists, Inc.)

George S. Bause, M.D., M.P.H., Honorary Curator, ASA's Wood Library-Museum of Anesthesiology, Schaumburg, Illinois, and Clinical Associate Professor, Case Western Reserve University, Cleveland, Ohio. UJYC@aol.com.