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Preoperative Anxiety: Does Anxiety Level the Afternoon Before Surgery Predict Anxiety Level Just Before Surgery?

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Although premedication prior to anesthesia and surgery can serve many purposes, current practice is to prescribe premedication largely to relieve anxiety.¹ The decision to administer premedication is generally based on the result of the preoperative interview by the anesthesiologist. Little research has been done to examine the relationship between anxiety witnessed during a preoperative interview, to the patient's state of anxiety just before s(he) is being transported into the operating room.

Patient interviews have been used in research studies to assess preoperative anxiety.^{2,3} However, quantitative techniques, such as rating scales and symptom enumeration, have become the standard for assessing moods⁴ and changes in mood after a stimulus,⁵ in addition, these quantitative techniques allow for fine determination between mild and moderate anxiety states.⁶ Multiple studies have shown a relationship between emo-

tional support and outcome.⁷⁻⁹ Given the extent of this research, it is surprising that the current standard techniques have been used so little for patients about to undergo surgery, and, in particular, for the time period immediately prior to surgery. The following study was designed to objectively compare patients' moods the afternoon before surgery to their moods immediately before transport into the operating room, and to test the hypothesis that patients' moods are similar at these two times.

METHODS

Over a 6-month period, patients between the ages of 21 and 60 yr scheduled to undergo abdominal operations estimated to last 1-4 h were asked to volunteer for a study to quantify mood changes prior to surgery. The study protocol and consent form were approved by our institutional human studies committee. Fifty-two consecutive patients met the criteria for study inclusion: they could complete information concerning name, date, and age, they were not currently receiving narcotics or anxiolytics, and they agreed to participate. We recorded demographics for each patient including details of age, sex, weight, operation to be performed, history of previous surgery, and whether the patient had been or might be diagnosed as having cancer. Patients completed the Profile of Mood States (POMS)¹⁰ both the afternoon before their surgery and again unpremedicated in the preoperative holding area, approximately 1 h prior to entering the operating room. The

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TABLE 1. Distribution of Types of Operations

Scheduled Operation	Number of Patients
Bowel resection	4
Cholecystectomy	4
Colostomy closure	4
Laparotomy	10
Liver resection	1
Splenectomy	1
Total abdominal hysterectomy	28

POMS was chosen because it is sensitive to momentary mood states, including anxiety. This questionnaire is a 72-item list of adjectives such as "friendly," "tense," "happy," and "angry." Patients were told to rate each of the adjectives according to the way they felt "right now" on a five-point scale from 0, "not at all," to 4, "extremely." The adjectives on the POMS have been factor analyzed into eight subscales labeled: Anxiety, Depression, Anger, Vigor, Fatigue, Confusion, Friendliness, and Elation. Each factor is scored by adding the points for its associated adjectives and dividing by the number of adjectives in the subscale. Reference values for the test were obtained from a group of college students who were volunteers for a drug study; they completed the POMS in the morning after an overnight fast and prior to administration of a drug. Anesthesia residents, previously educated in interviewing techniques designed to reduce anxiety and to meet legal requirements of informed consent, conducted preoperative evaluation and interviews with each patient. Their visits, however, were conducted independently of this study. In most cases, the POMS was completed prior to the resident's evaluation. No record, however, was made of this. We felt that, although an anesthesia visit might affect a patient's mood, so too might visits from nurses, surgeons, etc. Patients were free to take sleeping medications the night before surgery, if desired. Notation was made in the preoperative holding area as to

whether the patient had taken a sleeping pill the prior night.

Mood factors the afternoon before surgery and 1 h before surgery were compared using correlation coefficients and the Wilcoxon matched-pairs signed ranks test.¹¹ Stepwise logistic regression was used to find the best linear combination of predictors, including preoperative moods, sex, diagnosis of cancer, history of surgery, age, and weight, to classify patients according to whether or not they took a sleeping pill the night before surgery, and, in particular, to see if anxiety was significant in predicting who would take a sleeping pill.¹² The influence of sex of the patient, of history of previous surgery, of the possibility of cancer, of the ingestion of a sleeping pill, and of anxiety 1 day before surgery, on the level of anxiety 1 h before surgery was analyzed using stepwise multiple linear regression analysis.¹¹ All averages are presented as mean \pm one SD.

RESULTS

Fifty-two patients were studied over the 6-month period. The patients consisted of 40 woman and 12 men. Of the 52 participating, 40 patients had undergone previous surgery. Fourteen had or possibly had cancer. The average age was 40.1 ± 11.6 yr, and the average weight was 70.6 ± 14.7 kg. Fifteen patients took a sleeping pill the evening before surgery. Table 1 lists the type of operations and the number of patients scheduled for each operation.

The mean difference for each mood factor was calculated as the average of the score on the afternoon before surgery minus the average score 1 h before surgery. Mean scores, mean differences, correlation coefficients between the afternoon before and the day of surgery, and reference values for Anxiety, Depression, Anger, Vigor, Fatigue, Confusion, Friendliness, and Elation are shown in table 2. Reference values listed in table 2 were taken from a group of 45 college student

TABLE 2. Average Mood Factors the Afternoon Before Surgery, and in the Preoperative Holding Area; Difference;* and Correlation Coefficient†

	Reference ¹³ Values	Afternoon Before Surgery	Preoperative Holding Area	Correlation Coefficient	Mean Difference For Individual Patient's Difference	Significance for Mean
Anxiety	0.59	0.95 (0.89)	1.09 (0.96)	0.71	-0.14 (0.71)	NS
Depression	0.16	0.56 (0.63)	0.54 (0.67)	0.83	0.02 (0.38)	NS
Anger	0.15	0.42 (0.70)	0.38 (0.64)	0.89	0.04 (0.32)	NS
Vigor	1.50	2.19 (0.84)	1.73 (0.93)	0.75	0.46 (0.63)	$P < 0.001$
Fatigue	0.42	0.72 (0.73)	0.78 (0.81)	0.67	-0.05 (0.63)	NS
Confusion	0.55	0.31 (0.71)	0.33 (0.73)	0.76	-0.02 (0.50)	NS
Friendliness	1.77	2.77 (0.67)	2.48 (0.84)	0.74	0.29 (0.57)	$P < 0.001$
Elation	1.19	1.62 (0.72)	1.46 (0.80)	0.74	0.16 (0.56)	$P = 0.05$

See text for derivation of control values. Numbers in parentheses indicate standard deviation. Significance calculated by Wilcoxon matched-pairs signed-ranks test.

* Afternoon score minus score in holding area.

† Afternoon score correlated with holding area score.

volunteers for a drug study who completed the POMS in the morning prior to any drug testing.¹³ Anxiety levels in the reference population prior to a drug study were 0.59, almost half the anxiety of the surgical patients.

Vigor, Friendliness, and Elation were significantly lower in the preoperative holding area as compared to the afternoon before surgery. However, Anxiety was not significantly different in the preoperative holding area compared with the previous afternoon.

Stepwise logistic regression was used to find the best linear combination of predictors to maximize the classification of patients who did or did not take a sleeping pill the night before surgery, given their mood factors the afternoon before surgery, sex, diagnosis of cancer, history of previous surgery, age, and weight. This analysis identified only depression and specifically not anxiety as having a statistically significant correlation with taking a sleeping pill. The results of the analysis are shown in table 3.

Multiple linear regression analysis was used to relate anxiety seen in the preoperative holding area to various patient characteristics identified before the patient arrived in the preoperative holding area: mood factors the afternoon before surgery, sleeping pill, history of previous surgery, sex, cancer, age, and weight. Anxiety the afternoon before surgery was the only variable that could be included in the model to predict Anxiety in the preoperative holding area. Table 4 illustrates the regression equation, as well as certain diagnostics. The correlation coefficient of Anxiety the afternoon before surgery with Anxiety in the preoperative holding area was 0.708. A scattergram showing this relationship is illustrated in figure 1. Thus, anxiety the afternoon prior to surgery as detected by the POMS predicted anxiety measured by the POMS immediately preoperatively.

DISCUSSION

We tested the hypothesis that anxiety witnessed the afternoon or evening before surgery was similar to anxiety in the preoperative holding area. Since the type and amount of premedication is customarily based on impressions obtained the afternoon or evening before surgery, we sought to determine if patient moods, and, in particular, anxiety, were similar the afternoon before surgery and 1 h before surgery.

The average Anxiety score did not change from the afternoon before surgery to 1 h prior to surgery. Vigor, Friendliness, and Elation did decrease over that interval (table 2). Anxiety levels, as measured by the POMS, in our reference population was 0.59.¹¹ Anxiety has been shown to triple after simulated public speaking.⁶ Anxi-

TABLE 3. Results of Logistic Regression Analysis Relating Use of a Sleeping Pill to Mood Factors the Afternoon Before Surgery, Sex, Diagnosis of Cancer, History of Previous Surgery, Age, and Weight

Term	Coefficient	Standard Error	Coefficient/SE
Depression	1.02	0.55	1.87
Constant	-1.45	0.46	-3.15

Improvement Chi-square 4.12; $P = 0.042$. Goodness of fit Chi-square (D. Hosmer) 2.21; $P = 0.947$. Goodness of fit Chi-square (C. C. Brown) 0.86; $P = 0.65$.

TABLE 4. Results of Stepwise Linear Regression Analysis Relating Anxiety in the Preoperative Holding Area to Mood Factors the Afternoon Before Surgery, Sleeping Pill, History of Previous Surgery, Sex, Cancer, Age, and Weight

Variable	Slope (B)	Standard Error B	Standardized Slope	T	Significance
Preoperative anxiety	0.794	0.113	0.711	7.02	$P < 0.0001$
Constant	0.356	0.142		2.51	$P < 0.01$

$R = 0.712$; $R^2 = 0.506$; $F = 49.26$; Significance $P < 0.001$.

ety levels in our study, both the day before surgery and 1 h before surgery, were greater than reported in normal individuals, and were approximately the same as for individuals at the time of public speaking. Certainly statistical prediction does not guarantee individual prediction. There was a fan-like scatter relating Anxiety 1 day before surgery to Anxiety 1 h before surgery. The anes-

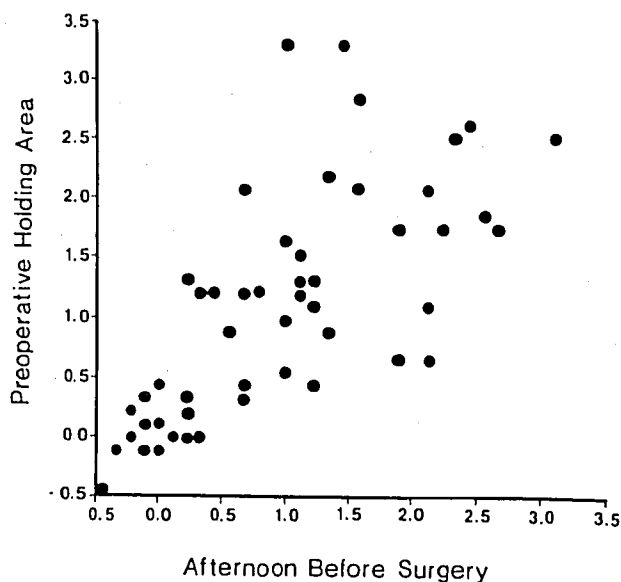


FIG. 1. Scattergram showing the relationship of Anxiety measured the afternoon before surgery to Anxiety measured in the preoperative holding area.

thesiologist still needs to remain sensitive to possible changes in anxiety that might increase or decrease the need for premedication. Anxiety seen in the preoperative holding area could be predicted from Anxiety seen the afternoon before surgery; Anxiety could not be predicted from any other factors, such as history of cancer, age, weight, sex, previous surgery, or the use of a sleeping pill the previous night. Hence, if anxiety is the determining factor in the prescription of a premedicant, that decision can be based on the preoperative interview.

Logistic regression analysis was performed to see if Anxiety was a predictor for ingestion of a sleeping pill the night before surgery. In addition, the ingestion of a sleeping pill the night before surgery was included in the multiple regression analysis, to see if its use was significantly related to Anxiety measured in the preoperative holding area. Preoperative anxiety did not predict sleeping pill ingestion, and sleeping pill ingestion did not predict Anxiety before surgery. Hypnotics have been shown to reduce preoperative anxiety,¹⁴ and to have no effect on Anxiety on the day of surgery.¹⁵ Further research is indicated to try to predict who does ask for a sleeping pill the day before surgery, and to see the effect of this medication on anxiety immediately before surgery. Studies of preoperative anxiety have shown that the majority of patients entering the hospital prior to surgery are either anxious or afraid.^{2,3,16} Norris and Baird revealed that 60% of patients are anxious the day before an operation.² Ramsay showed that 73% were anxious within 24 h of surgery.³ In a study by Johnston, anxiety levels were measured daily from before admission to several days following surgery.¹⁶ High levels were seen before admission, between admission and surgery, and following surgery, and were not restricted to the day before surgery. However, in that study, anxiety levels were not measured immediately before surgery. This study was designed to correct that deficiency by measuring anxiety levels both the afternoon before surgery and immediately before surgery, in the preoperative holding area.

In their classic study, Egbert *et al.*¹⁷ found that the preoperative visit by an anesthesiologist was more effective than a barbiturate in decreasing anxiety. Our patients had preoperative interviews designed to allay anxiety and to meet legal requirements of informed consent. These interviews were generally conducted after the POMS was administered, in the afternoon or evening before surgery. Anxiety 1 h before surgery was almost two times higher than in the reference group, and not different from that seen before the preoperative interview. Although obtaining the mandated modern informed consent might account for this difference

between our results and Egbert's study, the more accurate testing technique we used might also be responsible. Since these interviews to our patients were not monitored, however, it is also possible that they were not conducive to anxiety reduction. However, other patient contacts could have varied, including those among nursing, surgical, and other hospital personnel or family. These, too, were not controlled in our study.

Patients were asked, "How do you feel right now?" and not, "How do you feel today?" Certainly, idiosyncratic transitory momentary factors could influence results of the test. However, other investigators have not found that the different questions affect the measurement of state anxiety.¹⁸ Many of the studies on preoperative anxiety used preoperative interviews to judge anxiety.^{4,5,16} Objective measures of anxiety, such as the POMS, allow fine discrimination particularly between mild and moderate grades of anxiety.⁶

Anxiety would seem to be natural before a stressful life event, such as impending surgery. Further research is needed to judge the proper timing of preoperative medication and its effect on anxiety and such outcome variables as anesthetic requirement, postoperative pain relief, postoperative exhaustion, time of hospital discharge, and time to return to normal activity. The high level of anxiety seen 1 day prior to surgery indicates that treatment for anxiety before an operation in some patients might be more appropriately started earlier than just before a patient is going to the operating room. Perhaps an anesthesia interview in an outpatient facility at the time the operation is scheduled might help decrease anxiety in the period prior to surgery.

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Blood Flow Limits and Pulse Oximeter Signal Detection

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The pulse oximeter has achieved widespread use as a noninvasive monitor of arterial oxygen saturation. The popularity of today's oximeter technology can be attributed to several facts: vascular bed "arterialization" is no longer needed, inexpensive high-speed microprocessors for data acquisition and processing are available, and set-up times are minimal.¹ Pulse oximeters rely on the principle that fully oxygenated blood is only present during arterial pulsations.² Pulse detection algorithms identify the arterial component of light absorbance in a vascular bed. Two wavelengths of light (660 nm and 940 nm) are used to detect the presence of oxyhemoglobin and reduced hemoglobin, and Beer's law is applied to determine the hemoglobin saturation. Modern pulse oximetry has been described as "multiple-wavelength plethysmography."³

In addition to its role in determining hemoglobin saturation, the pulse oximeter has been advocated as a monitor for the rapid determination of adequate blood

flow to a limb, or as an indirect indicator of total body oxygenation.⁴⁻⁶ The physiologic basis for this recommendation has not been established. We employed a laser Doppler flow probe as a benchmark for determining the magnitude of peripheral blood flow. With this device, a rheometric study was performed to determine the pulse oximeter's sensitivity to pulsatile blood flow and its threshold for detecting arterial pulsation during artificially induced low-flow conditions.

MATERIALS AND METHODS

Ten human volunteers, age 25-38 yr, all healthy nonsmokers taking no medications, were studied. Approval by the Human Investigation Committee of our institution was obtained, and each participant provided an informed consent. One arm of each individual was stabilized on an arm rest, and a properly sized blood pressure cuff attached to a mercury manometer was placed on the upper arm. A Nellcor® D-25 pulse oximeter sensor was positioned over the ipsilateral second finger and attached to a Nellcor® N100 pulse oximeter (software version 6.8). The pulse oximeter was judged to be functioning properly if the displayed pulse rate matched the heart rate of the subject in the absence of error messages or alarm indications. No *in vivo* measurements of blood oxygenation were made during this experiment.

A laser Doppler flow probe (LD 5000 Capillary Perfusion Monitor, MedPacific Corp., Seattle) was used to

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