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Validation of an emoji-based Visual Facial Anxiety Scale (VFAS) for assessing preoperative anxiety: A comparison to the 'gold standard' State-Trait Anxiety Inventory (STAI-S) scale

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Abstract

Background: This observational, prospective cohort study was designed to assess the reliability and validity of an emoji-based Visual Facial Anxiety Scale (VFAS) for assessing preoperative (state) anxiety compared to the state anxiety subscale (STAI-S) of the 'gold standard' state-trait anxiety inventory (STAI) scale.

Methods: 293 adult patients undergoing elective surgical procedures were recruited to participate in a study performed in the preoperative evaluation area. The two anxiety scales were administered in a random order to assess the patient's level of preoperative anxiety. In addition, to the time required to perform each evaluation, both the patients and anesthesiologists were asked to choose the preferred anxiety assessment tool.

Main Results: There was a highly significant correlation ($p<0.0001$) between the VFAS ($r_s=0.552$) and the STAI-S anxiety scores. The Cronbach alpha-value was 0.715, indicating that VFAS is a reliable measure with good internal consistency for assessing anxiety. However, the STAI-S evaluation time (247± 55 sec) was significantly longer than the evaluation time for the VFAS (7.3 ± 1.6 sec). Compared to the STAI-S, the VFAS was preferred by 68% of the study patients for assessing their level of preoperative anxiety.

Conclusions: The VFAS scale was highly correlated (r=0.552) with the 'gold standard' STAI-S for assessing acute (state) anxiety while requiring significantly less time to complete.

Keywords: Preoperative anxiety; State-trait anxiety inventory (STAI); State anxiety subscale of the STAI scale (STAI-S); Visual facial anxiety scale (VFAS)

Introduction

The preoperative period is a stressful time for patients scheduled to undergo elective surgical procedures and can trigger adverse emotional, cognitive, and physiological responses. Acute preoperative (state) anxiety is reported to occur in 60-95% of patients in the period prior to entering the operating room [1-3]. Excessive preoperative anxiety levels have been linked to increased anesthetic and analgesic requirements, higher incidences of nausea, vomiting, and severe pain, as well as prolonged discharge times [4,5]. Anxiety has also been associated with an increased incidence of bronchospasm in asthmatic patients, delayed postsurgical wound healing, and elevated postoperative mortality rates after cardiac surgery.[6] Preoperative

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anxiety is often fueled by fears related to previous surgical or anesthetic complications.[7] Optimizing the assessment and treatment of preoperative anxiety might reduce some of these common perioperative complications and thereby, facilitate the recovery process [4,8].

Despite the widespread use of anxiolytic drugs for premedication in the immediate preoperative period, the patient's actual level of acute preoperative anxiety is not routinely assessed. It is unclear why an assessment of preoperative anxiety is not performed as part of the routine preoperative evaluation of patients by either the nursing staff or physicians. However, there are no current American Association Society (ASA) recommendations for evaluating preoperative anxiety. A possible explanation for the failure to perform a preoperative assessment of patient anxiety is related to the time constraints placed on nurses and anesthesiologists in the preoperative evaluation area. Although some anxiety assessment tools are very time-consuming to perform in a busy preoperative holding area, there are a variety of simple assessment tools which are based on a numerical or categorical scales and can be administered in <30 sec (e.g., visual analog scale from 0 [no anxiety] to 10 [extremely anxious]).

Emojis have become a widely accepted tool for communicating feelings in modern society. Emojis have the advantage of transcending cultural and language barriers while providing a simple visual means of communicating an individual's acute emotional state [9]. In a recent article in Anesthesia & Analgesia, King and Patterson suggested that emoji symbols will likely play an increasingly important role in perioperative medicine by facilitating the collection of clinically-relevant information [10]. A commonly used emoji-based assessment tool in anesthesia is the Wong-Baker FACES Pain Rating Scale (FACES-PRS). In a preliminary study our research group reported on an emoji-based visual facial anxiety scale (VFAS) for assessing anxiety by perioperative healthcare workers (namely, staff anesthesiologists, anesthesiology residents, and perioperative nurses) [12]. This preliminary study demonstrated that the VFAS could be implemented in routine clinical practice without adding significant additional work for the clinical staff. The original VFAS emoji-based anxiety assessment scale [13] contained 11-items (Figure 1a).

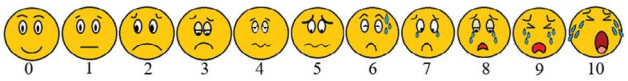

Figure (1a): Original Visual Facial Anxiety Scale (VFAS): Where the face on the left indicates no anxiety and the last face on the right indicates a high level of anxiety

However, a more simplified version of the VFAS (Figuer 1b) containing only 6 items was found to be as effective for assessing preoperative anxiety as the earlier 11-item version [12].

Figure (1b): The modified Visual Facial Anxiety Scale (VFAS): Where the face on the left indicates no anxiety and the last face on the right indicates a high level of anxiety

The primary objective of the current follow-up study was to validate the simplified VFAS by comparing it to the state anxiety scale of the 'gold standard' state anxiety inventory (STAI-S) scale with respect to its validity and reliability for assessing preoperative acute (state) anxiety in patients scheduled to undergo elective surgical procedures.

Material and Methods

This observational, prospective cohort study (IRB # Pro00043383) was approved by the Institutional Review Board (IRB) at Cedars-Sinai Medical Center in Los Angeles, CA. Of the 302 patients who met the study entrance criteria and gave written informed consent for participation between 2017 and 2018, 293 patients completed the study successfully. Nine patients withdrew from the study: five due to time constraints in the preoperative holding area preventing the completion of the required anxiety assessments, and four due to the rescheduling of their surgical procedures. The 293 ASA I-III patients (>18 yo) were scheduled to undergo elective surgery procedures (e.g., general, orthopedic, and OB/GYN). Patients with Alzheimer's disease, dementia, psychiatric disorders, or intellectual disability, as well as patients taking chronic anti-anxiety, antidepressant, or sedative medications, were excluded from participating in the study.

The attending anesthesiologists met with the consenting patients after they were admitted to the preoperative evaluation area and explained that the purpose of the study was to compare two different tools to measure preoperative anxiety. Subsequently, a signed written consent form for each patient was obtained. The investigator was present to observe the routine perioperative evaluations by the attending anesthesiologists and to record the method, if any, used to evaluate the patient's level of preoperative anxiety. When the preoperative evaluation by the attending anesthesiologist was concluded they left the area while a co-investigator performed the two anxiety assessments in the preoperative holding area and another co-investigator observed the amount of time (sec.) required by the patient to complete each of the anxiety assessments. Patient demographics were obtained from the medical records and medical history provided by the patients including age, gender, ethnicity, psychiatric history, co-morbidities, smoking, and substance abuse history. Additional demographic information included marital status, education

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level, current living situation, health insurance coverage, chronic anxiety (and use of anxiolytic medications), chronic pain medication, scheduled surgical procedure, previous anesthesia and surgical procedures, as well as any previous surgery and/or anesthesia-related complications.

Study procedure

After enrolling in the clinical trial, patients were administered the two anxiety measurement scales (VFAS and STAI-S) in random order to reduce bias associated with fixed-sequence testing. While patients completed the evaluation tools, a study staff member, not involved in administering the evaluations recorded the time it took each patient to complete each of the anxiety evaluation tools using a hand-held stopwatch. Time measurements were performed discreetly to minimize the 'Hawthorne' effect bias [14].

Following completion of the two anxiety evaluations, patients were asked to rank their preferred evaluation tool (i.e., specifying the assessment tool that they felt most accurately reflected their level of anxiety in the holding area), and they were asked the cause(s) of any preoperative anxiety. The specific causes of anxiety were selected by the patients from a list provided by the study personnel with the option to choose more than one cause, and included: (1) waiting to enter the operating room (OR), (2) fear of death, (3) insufficient information regarding surgery and (4) anesthesia, (5) fear of the operation or (6) anesthesia, (7) awareness during anesthesia, (8) fear of needles and other interventions, (9) fear of postoperative pain, sedation and/ or (10) postoperative nausea and vomiting, (11) need for a blood transfusion, (12) physical and mental harm, (13) lack of medical insurance coverage, (14) concerns about family and friends, (15) potential financial loss due to time away from work, (16) being at the mercy of medical staff, (17) and loss of control, and others.

They were also asked if there were any other factors contributing to their level of preoperative anxiety.

The anxiety assessment tool, if any, used by the attending anesthesiologist to evaluate the patient's preoperative anxiety was recorded and any notation in the chart regarding the patient's level of anxiety. All study evaluations were completed in the preoperative evaluation area prior to the patient entering the operating room (OR). Participants did not receive any sedative-anxiolytic premedication prior to the completion of the two anxiety evaluation tests.

Assessment tools

(**1**) The VFAS is a single-item self-reported scale with six faces showing different levels of anxiety, therefore providing six possible responses ranging from a smiley face to one showing extreme fear or anxiety (Figue 1b) [12]. The scale uses drawings of emoji-based faces as a universal and understandable non-verbal communication method that goes from (left to right) smiley to fearful expressions and possesses a suitable self-report measure of anxiety. The VFAS was presented to patients on a laminated card on letter-size paper and each facial expression was associated with both a numeric value from 0-to-10 and a descriptive term (e.g., no anxiety, low anxiety, moderate-to-high anxiety, and high anxiety. Specifically, face one (zero/no anxiety), face two (1-2/low anxiety), face three (3-4/low-moderate anxiety), face four (5-6/moderate anxiety), face five (7-8/ moderate-high anxiety), face six (9-10/ high anxiety).

Cutoff points: None-to-low anxiety (0-3), moderate anxiety (4-7), and high anxiety (8-10).

(**2**) The STAI is the 'gold standard' for assessing anxiety and it is commonly employed as a self-report assessment tool. It comprises two distinct 20-item evaluations (state and trait), with items rated on a 4-point Likert-type scale ranging from "not at all (1)" to "very much (4)" for the state subscale (Spielberger et al., 1983) [15]. For this study, only the state anxiety subscale (STAI-S) was utilized. Study score category/ value: None or low anxiety (< 39), moderate anxiety (39-46), and high anxiety (47-80). We considered patients with a score ≥46 on the STAI-State (STAI-S) as anxiety cases and used this score as a reference point as in Moerman's study [16]. The range of possible scores for form Y of the STAI-S goes from a minimum score of 20 to a maximum score of 80.

Cutoff points: None or low anxiety (< 39), moderate anxiety (39-46), and high anxiety (47-80).

Statistical Analysis

A sample size of 293 patients was compared via means based on the type of anxiety assessment tools. Means were compared by a power analysis assuming significant differences in time, preference, and reliability between the VFAS and STAI-S tools. The correlation among the patients' VFAS and STAI-S, being ordinal measures, was calculated using Spearman's rank correlation. A sample size of 293 patients produces a two-sided 95% confidence interval with a width equal to 0.20 under the null hypothesis that the sample correlation is at least 0.4 between VFAS and STAI-S using PASS 2008 software. Ranked data were used to draw comparisons similar to correlations to the Amsterdam Preoperative Anxiety [16] and Information Scale, with a score of 46 or higher on the STAI-S scale indicating a high level of anxiety [17-19].

The analysis was performed using SAS 9.4 for Windows (SAS Institute, Cary, NC, USA) and R. 3.0.1. The VFAS and STAI-S scales are ordinal variables, and the other variables are either binary, ordinal or categorical. Total numbers (n) and percentages (%) were presented for categorical measures, and the Chi-squared test and Kruskal Wallis tests were used for group comparisons. Median, mean values, and standard

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deviations were presented for continuous measurements. Internal consistency reliability was examined using Cronbach's α, with an acceptability criterion of ≥0.70. The Cronbach's alpha for VFAS and the STAI-S was calculated. Data are presented as median, mean ± SD, numbers (n), and percentages (%), with p-values ≤ 0.05 considered statistically significant.

Results

Validity and Reliability: Cronbach alphas were calculated to measure the internal consistency of the VFAS with STAI-S scales. The calculated value for Cronbach alpha between VFAS and STAI-S was equal to 0.715, indicating that VFAS has good criterion of reliability for assessing acute anxiety.[20] There was a significant Spearman's Correlation (SC) between the preoperative STAI-S anxiety scores and the VFAS scores (r=0.552), with p-value <0.0001 validating the VFAS scale. Anxiety levels on the VFAS and STAI-S scales had almost identical positive distributions on of the nineteen preoperative risk factors listed in a questionnaire as potential causes fear affecting the patients' preoperative anxiety, fourteen were statistically significant (p <.0001 to 0.03) by both tools and 4 by one of the two anxiety assessment tools (p <.0001 to 0.017) (Table 1).

A total of 293 patients (53% females and 47% males) participated in the study. Demographic and clinical characteristics of the study population are summarized in table 2.

The demographic variables that were associated with significantly different mean preoperative anxiety scores on either one or both of the anxiety scales were: (1) Gender (female vs male), (2) Age (< 40 yo vs > 40-60 yo and >60 yo), (3) Marital status (married vs single), living condition (living alone vs with others), (4) Previous surgery had higher anxiety scores than those undergoing their first operation, (5) Patients with prior anesthesia (vs those never had anesthesia), and (6) Patients who had 3-5 previous surgical procedures (vs. none, 1-2 or > 5 previous surgical procedures) (Table 2**).**

The comparative times required for performing the VFAS scale was 7.3 ± 1.6 sec vs., 246.7 ± 54.8 sec for the STAI-S evaluation (Table 3).

The means and standard deviations of the anxiety scale scores for the assessment tools were: VFAS 2.02±0.94, and STAI-S 34.21±10.39 (Table 3). The preferred preoperative anxiety scale (using a 4-point Likert rating scale) by the patients (68%) was the VFAS scale.

Table 1: Preoperative risk factors list of patients who selected each option for the cause of fear affecting preoperative anxiety.

Cause of Fear	Option Selected (n) (%)	VFAS	VFAS Spearman Rank Correlation	STAI State p values	STAI Spearman Rank Correlation
Waiting in pre-operation area	165, (56.3)	<.0001*	0.387*	<.0001*	0.488*
Pain	125, (42.7)	<.0001*	0.251*	<.0001*	0.38*
Concern about family	119, (40.6)	0.001*	0.197*	<.0001*	0.226*
No information about surgery	117, (39.9)	0.036*	0.122*	<.0001*	0.245*
No information of anesthesia	92, (31.4)	0.061	0.11	0.002*	0.171*
Needle prick	87, (29.7)	0.083	0.101	0.172	0.073
Afraid of operation	81, (27.6)	<.0001*	0.374*	<.0001*	0.514*
Not awakening	77, (26.3)	<.0001*	0.220*	<.0001*	0.351*
Loss of control	72, (24.6)	<.0001*	0.232*	<.0001*	0.302*
Awareness during anesthesia	69, (23.5)	<.0001*	0.257*	<.0001*	0.336*
Nausea and vomiting	64, (21.8)	0.002*	0.183*	0.002*	0.173*
Afraid of anesthesia	58, (19.8)	<.0001*	0.215*	<.0001*	0.309*
Physical and mental harm	53, (18.1)	<.0001*	0.243*	<.0001*	0.322*
Financial loss	49, (16.7)	0.083	0.101	<.0001*	0.201*
Medical insurance	49, (16.7)	0.16	0.082	0.013*	0.148*
Being at the mercy of medical staff	47, (16.0)	0.033*	0.125*	<.0001*	0.194*
Blood transfusion	46, (15.7)	0.017*	0.140*	0.107	0.102
No family friends together	25, (8.5)	0.187	0.077	0.004*	0.177*
Other reasons	5, (1.7)	0.93	-0.005	0.728	0.023

Visual Facial Anxiety Scale (VFAS), State-Trait Anxiety Inventory (STAI) scale.
Numbers (n), percentages (%), significant p value <0.05*
The Spearman Rank Correlations was calculated for VFAS and STAI-S separately for each variable. Thus, for each variable, there is one Spearman Rank Correlation with one p-value for VFAS and the other Spearman Rank Correlation with one p-value for STAI-S.

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Table 2: Demographic, clinical characteristics, types of surgery, and preoperative assessments of adult patients undergoing elective surgery

Variables	
Gender	female* (53%)/male (47%)
Age	<40 *(21%)/ >40 <60 (32%)/ >60 (47%)
ASA	1 (15%) /2 (50%) /3 (35%)
Marital status	married* (57%)/single (43%)
Living condition:	alone* (79.2%)/ with others (20.8)
Educational status (y)	<10y (0.3%)/ 10-15y (15.7%)/ >15 (84%)
Type of surgery	general (46%), orthopedic (27%)_Neuro-spine (16%),
	cardiothoracic (5%), vascular (3%), OB/GYN (3%)
Type of anesthesia	general anesthesia (76%), MAC sedation (24%)
Current Surgery	None (10%), 1-2 (34%), 3-5* (33%),
Sequence	>5 (22%), No answer (1%)
Patients with	prior Surgery (89%)
	prior Surgery with complications (9%)
	prior anesthesia (92%)
	prior anesthesia with complications (7%)

Percentages (%), Years (y)

Table 3: Mean (± SD) and median (range) anxiety scores and evaluation times for the two assessment tools.

Anxiety scale scores (minimum-maximum scores)	**Means value (± SD)**	**Median value and range**
VFAS (1-6)	2.02±0.94	2 (5-1)
STAI-S (20-80)	34.21±10.39	32 (70-20)
Evaluation Times (sec)		
VFAS	7.29 ± 1.61	7 (13-1)
STAI-S	246.7 ± 54.8	253 (562-130)

Visual Facial Anxiety Scale (VFAS), State Anxiety Inventory (STAI-S) scale.
Values are presented in Mean values ± standard deviation (SD)

Discussion

The current study focused on assessing the validity and accuracy of a novel emoji-based VFAS for assessing acute preoperative (state) anxiety compared to the 'gold standard' STAI-S scale. The use of emojis in healthcare communication presents several potential advantages for promoting more effective communication between patients and healthcare providers when dealing with non-native English-speaking populations. Emojis are widely accessible and reports indicate that >90% of online users regularly employ these symbols in their daily communications (e.g., text messaging, emails) [21,22]. An example of an emoji-based systems assessment tools in clinical medicine is the Wong-Baker FACES-PRS which is used as a paper or digitally-accessible emoji-based visual analog scale and can also be accessed using a smartphone [22].

For the VFAS anxiety assessment tool, we used a set of six widely recognized emojis that reflect different levels of anxiety from none-to-high levels to allow patients to communicate their level of preoperative anxiety to their healthcare providers in the immediate preoperative period [12]. In this validation study involving a comparison to the 'gold standard' STAI-S for assessing acute anxiety, both the patients and anesthesia providers preferred using the VFAS. Our findings using an emoji-based system for assessing anxiety are consistent with the findings of Wong and Baker using visual faces to assess the severity of postoperative pain [11]. These investigators also reported that while no single pain assessment scale demonstrated superiority with respect to validity and reliability, the facial-based pain scale was preferred by the patients and is currently widely used for assessing pain in clinical practices involving children [11,23]. Similar to Moerman's study [16], patients with a score ≥46 on the STAI-S were considered as anxiety and used this score as a reference point. The VFAS was very quickly performed by patients, and it could easily be incorporated into anesthesia providers' routine preoperative evaluation protocol. By routinely performing a preoperative assessment of anxiety, physicians could utilize a more targeted approach to prescribing anxiolytic premedicant drugs.

There was a significant Spearman's Correlation (SC) between the preoperative STAI-S anxiety scores and the VFAS scores (r=0.552), with p-value <0.0001). The VFAS not only offers a valid measure of state anxiety for adults undergoing elective surgery but also demonstrates good validity and reliability in assessing acute anxiety, as evidenced by a Cronbach alpha of 0.715 [20] when compared to STAI-S and the spearman rank correlation between VFAS and STAI-S is 0.561 (p-value<0.0001). The scores from VFAS and STAI-S in this study had similar statistically significant values ($p<0.05$) in ~74% (14/19) of the preoperative risk factors as the cause of fear affecting preoperative anxiety (table 1), showing the accuracy of the VFAS for preoperative anxiety evaluation.

An assessment of preoperative anxiety could also be incorporated into perioperative nursing evaluation analogous to the current pre- and postoperative assessment of pain (i.e., the 5th vital sign) [24]. The VFAS could also prove to be useful in facilitating the assessment of preoperative anxiety in children (which has been reported to be as high as 30-75%

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and is associated with similar adverse perioperative outcomes as adults) [25]. The earlier version of this VFAS has been utilized in several studies assessing anxiety in children and adults [26-38].

Study limitations

Our study findings are based on subjective evaluations which rely on the patients' accurately reporting their preoperative anxiety level. This study was an observational study from which causality cannot be inferred and the findings from the preoperative anxiety assessments were not used to direct the administration of premedication. These preliminary findings will hopefully encourage anesthesiologists and perioperative nurses to begin routinely evaluating anxiety in the preoperative period and utilize this information to optimize the administration of anxiolytic premedication.

Conclusion

The novel VFAS was correlated with the 'gold standard' STAI-S for assessing anxiety in the immediate preoperative period while requiring significantly less time to complete (~14 sec vs. > 4 min) and could be a useful tool for the routine assessment of preoperative anxiety. A Cronbach's α-value of 0.715 and a spearman rank correlation between VFAS and STAI-S is 0.561 (p-value<0.0001 demonstrated that the VFAS had good internal consistency and reliability. Finally, we would speculate that incorporating a simple assessment anxiety tool as part of the routine preoperative evaluation process could improve overall patient care and potential reduce adverse perioperative outcomes.

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