Preoperative anxiety occurs in many surgical patients and yet there are no clear recommendations on how to provide the best evidence-based care to these patients during a general anesthetic. The following case report describes a complex case of a 35-year-old female who presented for imaging under general anesthesia with high preoperative anxiety. She displayed fluctuations in hemodynamics, an increased induction dose of propofol, and vasopressor support throughout the intraoperative phase of care. This case report describes the current evidence for considerations of high anxiety operative patients, which may include an increased induction and total dose of propofol, increased analgesic requirement, and an individualized preoperative assessment to establish a baseline anxiety level and proper education.

**Keywords:** Anesthesiology, general anesthesia, intraoperative anesthesia, preoperative anxiety.

Anxiety is a subjective response that occurs during an anxiety-provoking stimulus, such as public speaking or surgery, causing nervousness and tension.3 **Trait anxiety** is a personality trait, possibly pre-diagnosed, whereby the individual responds in a predictable pattern to a perceived stressful situation.3 High trait anxiety in patients typically corresponds with higher levels of state anxiety preoperatively. Preoperative anxiety occurs in 11%-80% of patients, but current practice lacks clear evidence-based care guidelines to support these patients.4

She had recently been diagnosed with lymphoma after presenting to the emergency department with left arm swelling from a deep vein thrombosis with a subsequent computerized tomography (CT) of her chest showing a large mediastinal mass. She was admitted to the hospital and received a psychiatric evaluation due to her erratic behavior, hallucinations, and lack of routine psychiatric care. The patient was not on any scheduled medications for underlying conditions or her psychiatric disorder. It is unclear if the patient was ever previously prescribed medications for her psychiatric disorder due to the patient not remembering.

The patient presented to the MRI suite with her mother and the anesthesia plan was discussed with both persons. Her physical assessment was normal except for the patient being tachycardic, anxious, and tearful. The echocardiogram was reviewed and appeared normal with no superior vena cava (SVC) syndrome, which was a concern upon her admission. The patient was induced on a gurney in zone three of the MRI suite with her mother at the bedside holding her hand. Her pre-induction vital signs included a heart rate of 128/min, blood pressure of 125/78 mm Hg, and an oxygen saturation of 97% (SpO2) on room air. The patient remained anxious and tearful through induction. Midazolam was withheld due to its potential teratogenic effects.

The plan was discussed with the anesthesia team to provide general anesthesia due to the patient’s anxiety level, MRI technicians requiring breath holds for imaging, and greater control of the patient’s airway due to her mediastinal mass. The patient was only 12 weeks pregnant and had followed nothing by mouth (NPO) guidelines, so we proceeded without a rapid sequence induction (RSI) to provide a smooth induction and intubation and
minimize large fluctuations in hemodynamics. General anesthesia was induced with the administration of 120 mg of lidocaine, 180 mg of propofol (2.5 mg/kg), and 50 mg of rocuronium. The patient’s trachea was intubated with a 7.0-cm cuffed endotracheal tube and placed on volume control ventilation. Anesthesia was maintained with a sevoflurane end-tidal concentration of 1.5%-1.8%. The patient remained tachycardic at 110-120/min through induction and most of the imaging but did become hypotensive and required a phenylephrine infusion at 0.5 µg/kg/min to maintain a mean arterial pressure (MAP) greater than 65 mm Hg. After 90 minutes of anesthesia the patient’s heart rate decreased to 90-115/min and continued to require a vasopressor infusion. Upon completion of the MRI the patient was transported intubated and sedated with propofol at 150 µg/kg/min to interventional radiology (IR) for a bone marrow biopsy, lumbar puncture, and central line placement. Total anesthesia time for the MRI was approximately 2 hours and 30 minutes. Following completion of the IR procedures, the patient was titrated off the phenylephrine infusion, extubated, and transferred back to inpatient care without complications.

Discussion

Spielberger’s state-trait anxiety inventory (STAI) has become the gold standard for quantifying preoperative anxiety in patients and is completed by self-report.4 There are two sub-scales measured, state and trait anxiety, which contain 20 questions per sub-scale and each question is measured with a four-point score (Table).5 The state anxiety sub-scale contains questions regarding how the patient is feeling in that moment. The trait anxiety sub-scale questions a patient’s proneness to anxiety by asking generalized questions with responses such as “sometimes” or “almost always”.5 Scores may range from 20-80, with a higher score indicating a higher level of anxiety.5 It is generally accepted that a score greater than 40 indicates anxiety is present and the majority of studies declare a score of 46-50 or greater to be equivalent to high anxiety.5,6

One study found that the STAI state anxiety scores could help predict a 20% hemodynamic change in blood pressure and heart rate during induction of patients who were older than 45.6 However, this study did not clarify whether the heart rate and blood pressure increased or decreased during induction. Other risk factors for perioperative anxiety that can be considered include the female gender, socioeconomic status, education level, and type of procedure being performed (GI, OB, and gynecological surgery are most predictive), but current studies have inconsistent results and recommendations to utilize these factors to predict increased anxiety.7-9 Previous positive anesthesia experiences and adequate patient education are two factors associated with lower levels of preoperative state anxiety.2 State anxiety levels can be decreased when a patient feels well-informed prior to surgery or when the educational process is individualized to the patient.2,9

A patient’s mean platelet volume (MPV) may also be an indicator for anxiety, since platelets can be used as a bio-chemical marker of alterations occurring in the brain due to anxiety.10 Large platelets, measured by MPV, have displayed increased enzymatic and metabolic activity, which can form a relationship between platelet activity and anxiety and depression. The increased MPV and associated increased preoperative anxiety has been shown to increase propofol use at 30 minutes of anesthesia time.10 Therefore, measuring MPV in the preoperative phase may help indicate increased anxiety and predict the need for increased amounts of propofol.10 The patient in this case study had a relatively normal MPV value (6.9 fl), so it is unlikely that MPV would have indicated the patient’s anxiety would require increased requirements of propofol use for this case.

In addition to the patient in this case study having anxiety, she was also pregnant and had a history of BD, which could have been contributing factors to the changes seen throughout the case. Normal changes during pregnancy include an increased heart rate, shortness of breath, gastric reflux, dizziness, and sweating.11 These changes can mimic symptoms of anxiety and make diagnosis difficult. Anxiety occurs in 8.5%-25% of all pregnancies, which can put the mother and fetus at an increased risk of complications.11,12 During early pregnancy, anxiety can lead to loss of the fetus, while later in pregnancy, during the second and third trimesters, it can cause low birth weight, increased risk of preterm labor, and low Apgar scores.11 If anxiety is chronic or becomes extreme during pregnancy, it may cause changes in the normal uteroplacental blood flow, leading to decreased oxygen and nutrient delivery to the fetus.12 The increased cortisol level caused by anxiety has been associated with reduced brain growth in the fetus.12 Although there is little data and research to establish the effectiveness of treatment for anxiety during pregnancy, it is still important to identify in order to manage the symptoms and treat with both cognitive-behavioral therapy (CBT) and psychopharmacy.11 In patients with BD, the most prevalent comorbidity is anxiety disorder, which occurs in 45% of cases.13 The presence of anxiety with BD typically occurs during depressive episodes, and can lead to an increased total number of depressive occurrences and a longer time to achieve remission of symptoms.13

Increased preoperative anxiety can cause a more active sympathetic nervous system at baseline that leads to higher baseline blood pressure, heart rate, and levels of cortisol and catecholamines.14 Patients with high STAI anxiety scores have been shown to have increase arterial blood pressure and heart rate in the intraoperative period, and also a decreased SpO2 level when compared to a low anxiety group.4 Trait anxiety, represented by a
patient’s level of worry, has been associated with a decreased cardiovascular response and variability in heart rate when presented with an anxiety-provoking stimulus. High preoperative anxiety has also been shown to have a decreased intraoperative cortisol response. These changes in the hemodynamic response for high anxiety patients can also affect the amount of medication needed for sedation and analgesia. Another important consideration in the case discussed was the lack of painful stimuli, since the anesthesia was provided for an imaging procedure. This could also alter the medication requirements.

High levels of preoperative anxiety, both state and trait, have been shown to require an increased induction dose, total dose, and a higher concentration on a target-controlled infusion of propofol in order to achieve and maintain sedation. Anxiety has also been associated with increased movement during sedation cases. For general anesthesia cases, a landmark study found that patients with high trait anxiety were shown to require a higher dose of propofol for induction and maintenance, and their high trait anxiety score can serve as a predictor for the intraoperative requirement of propofol. However, in 2008, Morley et al found that high preoperative anxiety (measured by the STAI) did not affect the induction dose of propofol required for general anesthesia.

When planning for the postoperative period, the anesthesia provider can also consider postoperative complications more common in high anxiety patients. Anxiety has been found to be a common predictor for the intensity of postoperative pain and analgesic consumption. By identifying a patient’s preoperative pain and anxiety level, the anesthesia provider can better predict postoperative analgesic requirement. Postoperative nausea and vomiting and unplanned admissions have also been associated with high preoperative anxiety.

A preoperative anxiolytic (midazolam) was used routinely in some of the studies dosed on a weight-based scale. A study by Osborn used midazolam for every patient prior to induction and found a greater total dose of propofol was still required to achieve and maintain anesthesia when a patient had high preoperative anxiety. The study investigating MPV also used midazolam (0.02 mg/kg) in the preoperative phase of care and also found additional propofol requirements. Other studies did exclude preoperative medications in order to mitigate the potential contributing effects it may provide and to focus on the effects of specific techniques or medications. The patient in this case study did not receive midazolam, a benzodiazepine, preoperatively because it is a United States Food and Drug Administration category D medication. Category D suggests that studies have demonstrated that the drug poses a risk to the fetus and are not recommended in pregnancy.

Although this case had no major complications, it did reveal that there are areas that could use improvement. Current recommendations vary on when an RSI should be performed on a pregnant patient, but range from the beginning of the second trimester (12-13 weeks) to 18-20 weeks gestation. Beginning in the second trimester the lower esophageal sphincter loses tone and there is an increase in intra-abdominal pressure, which makes the patient at a higher risk of aspiration. Another way to reduce the risk of aspiration is to preoperatively administer antacid prophylaxis, which is recommended after 14 weeks gestation. Since this patient was 12 weeks pregnant, both precautions could have been implemented.

There are many ways to assist an anesthesia provider in determining a patient’s level of anxiety, but some patients do not require lab values or evaluation tools to notify a provider of their anxiety. The patient from this case report was evidently anxious upon the initial examination, like many patients presenting for surgery may be. Once this assessment has been made, the anesthesia provider can then anticipate a need for an increased initial propofol requirement along with greater fluctuations in hemodynamics that may require additional medications. Both her anxiety and pregnancy increase the patient’s risk of postoperative nausea and vomiting (PONV), so appropriate anti-emetics should have been administered as well.

In a typical surgical patient that requires anesthesia that is not pregnant and presents with anxiety the anesthesia provider must tailor the care of this patient from the preoperative assessment all the way to postoperative care and discharge. In the preoperative phase a baseline pain assessment needs to be conducted, education should be provided so the patient has clear expectations of the proceeding events and allow time for all questions to be answered. An anxiolytic like midazolam should be administered when appropriate. The anesthesia provider should prepare for fluctuations in hemodynamics and

<table>
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<th>Not At All</th>
<th>Somewhat</th>
<th>Moderately</th>
<th>Very Much</th>
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</thead>
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<td>2</td>
<td>3</td>
</tr>
<tr>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3. I am tense</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4. I am strained</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5. I feel at ease</td>
<td>1</td>
<td>2</td>
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Table. Spielberger’s State-Trait Anxiety Inventory (STAI) State Sub-scale Example
increased propofol requirements in the intraoperative period. A bispectral index (BIS) monitor can be utilized to ensure an adequate sedation level. The anesthesia provider should also anticipate increased analgesic requirements in preparation for the postoperative period.

There were limitations to the studies conducted, which include using different tools for measurement that makes comparisons between studies more difficult. Some studies used a visual analogue system (VAS) instead of the STAI to measure anxiety. Arterial blood pressure measurements for continuous hemodynamic monitoring were rarely used, instead favoring noninvasive blood pressure monitoring. Only three of the studies found used a BIS monitor to provide a quantitative number for sedation level. Another limitation to the studies was the variation in procedures the patients were receiving, which could affect the level of anxiety. Recommendations for future research include using the STAI tool to measure anxiety and establish clear preoperative baseline pain and anxiety levels. For non-MRI cases, a BIS monitor is recommended to quantify and compare sedation levels and place an arterial line for continuous hemodynamic monitoring. Another recommendation would be to conduct a study specifically on patients with pre-diagnosed trait anxiety and the effect that general anesthesia has on them, which to our knowledge has not been conducted.

Conclusion
Preoperative anxiety is a common occurrence in patients undergoing anesthesia for surgery. In order to optimize anesthesia care and safety for these patients, an anesthesia provider needs to individualize care in every step of the process. While completing the preoperative evaluation, it is important to assess the patient’s current anxiety and pain level, history of anxiety, and subjective feelings of past procedures. An anesthesia provider can anticipate possible intraoperative and postoperative needs by identifying common predictors associated with increased anxiety and assessing baseline hemodynamics. There can also be a focus placed on alleviating current anxiety in the preoperative period by providing thorough and individualized education to the patient regarding the anesthesia plan and by giving the patient the opportunity to voice concerns and ask questions. In the induction and intraoperative period, these patients can be expected to require increased doses of propofol and analgesics with fluctuations in hemodynamics. This was a complex case that demonstrated the specific considerations of high-anxiety patients that are required in the intraoperative period.

REFERENCES
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