

# Non-operating Room Anesthesia



## The Principles of Patient Assessment and Preparation

Beverly Chang, MD<sup>a</sup>, Richard D. Urman, MD, MBA<sup>b,\*</sup>

### KEYWORDS

- Non-operating room • Anesthesia • Preoperative • Evaluation • Assessment
- Procedural sedation

### KEY POINTS

- Non-operating room (OR) anesthetics are becoming increasingly commonplace, which often entails taking care of patients who are more medically challenging than patients in the OR.
- Preoperative assessment may require a greater degree of resource coordination.
- Non-OR procedures present significantly different challenges for anesthesiologists during preprocedure, intraprocedure, and postprocedure periods.
- There are significant ways in which anesthesiologists can add value and optimize efficiency in the non-OR realm.

### INTRODUCTION

Over the last decade, there has been a shift from procedures being performed strictly in the operating room (OR) to less familiar locations within the far reaches of the hospital as well as outside of the hospital setting. Especially given an increase in the aging population with a significant disease burden, more procedures are being performed in non-OR locations to take advantage of noninvasive techniques that potentially impart less risk. Increasingly complex procedures are being performed in these settings in a population that may not be amenable to traditional surgical correction. In addition, a growing number of urgent and emergent procedures with medically unstable patients are increasingly common occurrences in these areas.

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<sup>a</sup> Department of Anesthesiology, Perioperative and Pain Medicine, Stanford Hospital and Clinics, 300 Pasteur Drive H3580, Stanford, CA 94305, USA; <sup>b</sup> Department of Anesthesiology, Perioperative and Pain Medicine, Brigham and Women's Hospital, 75 Francis Street, Boston, MA 02115, USA

\* Corresponding author.

E-mail address: [RURMAN@partners.org](mailto:RURMAN@partners.org)

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## CHALLENGES OF NON-OPERATING ROOM PROCEDURES

Performing procedures outside of the OR creates a new set of challenges for anesthesiologists. Patients scheduled for non-OR procedures are often selected by the severity of their disease, which prevents them from undergoing a major procedure in the OR. These patients are sometimes more medically compromised and less optimized compared with the general OR population. For some practitioners, the firmly established familiarity with the OR and its resources is suddenly stripped away. Many of the non-OR sites are located deep within the trenches of hospitals that often require guides to locate for first-time visitors. Resources such as space, monitors, anesthesia equipment, and medications may oftentimes be scarce or hidden. These locations are often built without an anticipation for anesthesia needs and equipment, and additional skilled personnel may be located far away. All of these difficulties create a unique challenge that each anesthesiologist faces when delivering anesthetics in these locations.<sup>1,2</sup>

As the interventional medical technology continues to advance, increasingly complex procedures are being performed in all areas of non-OR specialties. In each hospital setting, the number of non-OR cases performed is growing at a startling pace. A medically complex patient population is often seen, and emergent procedures are commonplace. Anesthesiologists are tasked with providing anesthetic care to patients who are “too sick” or too frail for the OR in procedure rooms that are sometimes not staffed or equipped to handle these patients. There is significant pressure to perform fast evaluations with oftentimes only limited information, because many patients first present on the day of the procedure or are scheduled as urgent or emergent cases. Anesthesiologists may be expected to recover patients in busy recovery suites without dedicated extended postoperative monitoring capabilities and with staff who may not routinely recover patients from general anesthetics. In other instances where anesthetic care by anesthesiologists was not originally anticipated, anesthesiologists often become the first responders to emergent situations where little to no information about the patient is available. Many patients are referred directly to the proceduralist by their regular providers, without the benefit of a thorough preoperative evaluation until the day of the procedure; this is also true of urgent and emergent add-on cases, where little time is available to properly prepare the patient for anesthesia and optimize their comorbid conditions.

The reality is that many interventional procedures do not require anesthesia care, but rather sedation by nonanesthesia providers. However, compliance with existing standards of care for procedural sedation needs to be assured, regardless of the location or the administering staff. Anesthesiologists will need to be the advocates for setting standards and assuring compliance during procedures involving sedation by nonanesthesiologists, in accordance with American Society of Anesthesiologists (ASA) procedural sedation guidelines.<sup>3,4</sup> There is also a growing involvement of state and federal regulatory agencies. By monitoring outcomes and procedural events, these agencies will continue to scrutinize non-OR areas where sedation or anesthesia is being administered. Anesthesia and nonanesthesia physicians working in the non-OR environment must ensure that the goals of medical optimization and regulatory compliance that OR staff face are met in other areas. By the same token, anesthetic care is mandated to be held to the same standard regardless of the location where it is administered, as decreed by the Joint Commission on Accreditation of Healthcare Organizations and the Center for Medicare and Medicaid Services.<sup>5</sup>

With the growing number of non-OR procedures, a significant number of patients now require assessment before their procedural date. Many hospitals have a preoperative clinic or some kind of preoperative process in place to assess patients

scheduled for the OR, but many may not have the resources to handle this additional influx of patients. Anesthesiologists usually play an important role in initiating and maintaining a preoperative clinic. However, funding and staffing of such clinics may be challenging due to concerns of where the financial backing of such clinics should fall: should it be the hospital, anesthesiology, surgery, or procedural departments? Non-OR consults often create a strain on anesthesia departments, as “curbside” consults are generally not billable. Official anesthesia consults are billable but do not generate substantial value while requiring a significant amount of staff time. Many non-OR evaluations are performed on the day of the procedure, but this may be more costly by increasing the risk of procedural cancellations or delays.<sup>6</sup> In addition, establishing an organized process with a buy-in from all involved specialties and hospital administration establishes more efficacy, patient safety, and satisfaction for all stakeholders involved.

A formal triage process with protocols needs to be established. The staff placed in the preoperative assessment role, such as physicians and nurses, needs to be educated on proper triaging and selection of patients appropriate for each procedure and sedation.<sup>7,8</sup> Each facility needs to develop criteria that would automatically trigger an anesthesia consult for patients at risk of failing procedural sedation. Stringent education efforts are necessary to provide nonanesthesiologists with key preoperative assessment points and proper sedative selection. An additional challenge is the urgency of some procedures that oftentimes precludes a proper preoperative assessment. A process needs to be in place to triage these patients and provide the proper anesthetic and procedural care under emergent situations. Most importantly, a process needs to be established to communicate and notify treatment teams of concerning findings and comorbid conditions that may affect the procedure and anesthetic offered.

## QUALITY ASSURANCE

Continued quality assessments of the preoperative process need to be performed to maintain appropriate patient selection and evaluation for non-OR cases.<sup>9</sup> The number of anesthesia preoperative consults per day should be quantified as should the number and reason for case delays and cancellations. The number of intraoperative consultations requested and urgency of the procedure should be noted. These measures will allow for a periodic review of institutional guidelines and processes related to the appropriateness of each selected procedural modality and the involvement of anesthesia providers. A multidisciplinary committee should be formed to review each incident report related to sedation and anesthesia complications. Many of these initiatives can be championed by anesthesiologists who are familiar with the unique challenges of patient comorbidities and sedation techniques.

## ADDING VALUE AS ANESTHESIOLOGISTS

Anesthesiologists are the natural safeguards for patients requiring any type of procedural sedation. With unique training in preoperative triaging and other aspects of perioperative management, anesthesiologists ensure a smooth transition for both patients and proceduralists in the perioperative process whether in or out of the OR. Studies have demonstrated cost savings and increased efficiency when preoperative evaluation and testing is performed by anesthesiologists.<sup>10,11</sup> Hospitals place significant effort into increasing the efficiency of the OR, setting up preoperative clinics, pain management teams, and after-anesthesia care unit resources to maximize revenues. These same efforts now need to be directed to the non-OR realm. Supporting a

preoperative assessment system reduces the costs of non-OR cancellations and delays, leading to increased efficiency and an ability to perform more procedures per day. Numerous studies have demonstrated the financial justifications of establishing an organized preoperative assessment process.<sup>12,13</sup> Cost reductions can be seen in decreasing nonreimbursed preoperative laboratory and diagnostic tests as well as unnecessary preoperative consultations by specialty clinics. Reimbursements can be maximized by standardization and accuracy of documentation, compliance with pay-for-performance measures, and reimbursements for preoperative assessments. Preoperative medical management reduces potential complications, hospital costs, and length of stay. Lastly, a smoother, safer, and more streamlined process contributes to greater patient satisfaction.<sup>6</sup>

## ANESTHESIA VERSUS PROCEDURAL SEDATION

Traditionally, most non-OR procedures have been performed without the presence of anesthesiologists but under sedation administered by nonanesthesiologists. However, as increasingly complex procedures are introduced and patients with more severe comorbidities are being scheduled, anesthesiologists have an increasing presence in non-OR procedural rooms. With the advent of new technologies, whether a patient or a proceduralist requires an anesthesiologist is a key question to ask during each preoperative assessment. Numerous studies have demonstrated the complications of sedation and anesthesia in the non-OR setting.<sup>1,14,15</sup> A recent review of approximately 63,000 non-OR cases in a tertiary care center described adverse events associated with all types of sedation and anesthesia, advocating for a robust quality assurance system to track and report such events.<sup>16</sup>

For example, the ASA Closed Claims analysis by Metzner and colleagues<sup>17</sup> revealed that the most common non-OR anesthesia (NORA) claims were related to severe respiratory events leading to death and permanent brain damage, which occurred twice as frequently as in the OR. NORA was associated with a greater degree of injury compared with OR claims, whereas patient mortality was almost double that observed in the OR (54% in NORA vs 29% for OR claims). Respiratory depression as a result of anesthetic overdose accounted for 30% of all monitored anesthetic care claims. In most cases, the care was deemed to be substandard and preventable with improved monitoring, such as adherence to basic ASA monitoring standards. Furthermore, in 15% of the cases, monitoring with a pulse oximeter was absent. Fifty-four percent of care in NORA locations was deemed to be substandard, and injury was determined to be preventable in up to 32% of the cases. Most of the OR claims occurred in the gastroenterology, cardiology, or emergency departments and involved significantly elderly and medically complex patients.<sup>17,18</sup> A large database analysis of the National Anesthesia Clinical Outcomes Registry of the Anesthesia Quality Institute revealed cardiology and gastroenterology patients to be more medically complex and older as compared with the OR population. Although overall rates of complications were still greater in the OR, subgroup analysis revealed an increase in both major and minor complications as well as higher mortalities among cardiology and radiology patients in NORA locations.<sup>19</sup> Karamnov and colleagues<sup>20</sup> demonstrated that more than 5% of cases associated with adverse events were related to incomplete history taking in the preoperative process. Greater than 10% of cases were due to lack of proper intravenous (IV) moderate sedation certification in the administering staff. Overall data from both closed claims and database analysis from the AQL indicate that many NORA complications may be preventable with increased vigilance and adherence to the same standards of anesthetic care that is required in the OR.

The inclusion of an anesthesiologist is typically made by the request of the proceduralist. Many institutions have guidelines in place for certain comorbidities or certain procedures that identify the need for anesthesia assistance.<sup>21</sup> Long procedures that have the potential for needing surgical backup and cases that may precipitate instability should at least warrant an anesthesia assessment.<sup>22</sup> In some high-risk sedation cases, it is important to ensure that anesthetic backup is readily available, even if there is no continuous anesthesia presence initially required for the procedure. However, patients should be carefully evaluated and selected to receive anesthesia consultation in order to maximize efficiency in workflow and in use of both anesthesia and hospital resources. If cases or consultations are not appropriately scheduled, the ability to provide anesthesiology services to out-of-OR locations may not be financially feasible.<sup>23</sup> Ultimately, this decision for anesthesia or procedural sedation with a nonanesthesiologist needs to be made on an individual basis. Certain procedures mandate the presence of an anesthesiologist to deliver general anesthetics and paralytics. Other procedures, such as endoscopies and colonoscopies, may commonly be performed with nonanesthesia sedation. However, specific patient characteristics may require the presence of anesthesia staff even in the most routine procedures. **Box 1** outlines patient-specific factors that may require an anesthesia consultation to evaluate for a need for anesthesia services during the procedure. However, one recent report acknowledged that even though there are numerous studies on sedation practices in the non-OR setting, there is a dearth of high-quality studies, especially the ones comparing patient outcomes between different types of practitioners and specialties.<sup>24</sup>

**Box 1****Patients who may require an anesthesia consult**

ASA class III, IV

Anticipated difficult airway (dysmorphic facial features, oral abnormalities, neck abnormalities, jaw abnormalities)

Severe pulmonary disease

Obstructive sleep apnea

Obesity (body mass index >35)

Coronary artery disease, prior myocardial infarction, angina, valvular disease

Congestive heart failure

Pacemaker/defibrillator

Extremes of age

Pregnancy

Substance abuse

Failed procedural sedation

Unable to assume position needed for procedure

Patients with chronic opioid use

Patients who request an anesthesiologist

Personal or family history of significant problems with anesthesia (ie, malignant hyperthermia)

*Adapted from* Bader AM, Pothier MM. Out-of-operating room procedures: preprocedure assessment. *Anesthesiol Clin* 2009;27(1):121–6.

Anesthesiologists are known for their contingency planning for the worst possible outcome or scenario and for devising ways to prevent or minimize complications. Careful examination of each patient's history and comorbidities during the preoperative assessment can provide the means to anticipate adverse events, ideally tailored to each patient and procedure. This type of planning is just as important in the non-OR setting. Preoperative planning in the non-OR setting should be focused on a few important points.<sup>23</sup> These include the following:

1. Familiarity with the location and resources of the anesthetizing location
2. Understanding the planned procedure and the requirements to perform it, such as type of positioning, duration, necessary level of immobility and sedation, and so forth
3. A thorough medical screening of the patient and medical optimization for all disease states
4. Determination of the need for an anesthesiologist to perform the procedure

There are several guidelines related to providing care in the non-OR locations. For example, according to the ASA Statement of Non-operating Room Anesthetizing Locations, minimum requirements for providing care include the following<sup>25</sup>:

1. A reliable source of oxygen adequate for the length of the procedure as well as a backup supply. A central oxygen source is preferred and a back-up source should include at least a full E cylinder
2. A reliable suction source
3. An adequate system for scavenging waste anesthetic gases
4. A self-inflating resuscitator bag capable of administering at least 90% O<sub>2</sub> as a means to deliver positive pressure ventilation
5. Adequate anesthetic drugs, supplies, and equipment for the intended anesthetic care
6. Adequate monitoring equipment that adheres to the ASA Standards for Basic Anesthetic Monitoring, which should be applied to all cases involving general anesthesia, regional anesthesia, and monitored anesthesia care<sup>26</sup>
  - a. Qualified anesthesia personnel should be present throughout to conduct any anesthetics
  - b. During all anesthetics, oxygenation, ventilation, circulation, and temperature should be continually (regularly and frequently) monitored using the following:
    - i. Oxygenation: oxygen analyzer, pulse oximeter
    - ii. Ventilation: chest excursion, breath sounds, expired carbon dioxide monitoring, capnography, disconnection monitors
    - iii. Circulation: electrocardiogram, arterial blood pressure and heart rate monitoring, palpation of a pulse, auscultation of heart sounds, intra-arterial pressure monitoring, peripheral pulse monitoring or pulse oximetry
    - iv. Temperature probe
7. In any location where inhaled anesthetics are used, there should be an anesthesia machine equivalent in function to that used in the OR and maintained to current OR standards
8. Sufficient electrical outlets that adhere to facility standards
9. Adequate illumination of the patient and equipment
10. Sufficient space to accommodate necessary equipment and personnel to allow fast access to the patient and equipment when needed
11. Immediate access to an emergency cart with a defibrillator, emergency drugs, and other equipment to provide cardiopulmonary resuscitation
12. Adequate anesthesia support staff should be readily available at each location

13. Appropriate provision of after-anesthesia management and recovery with properly trained staff and monitoring equipment

### ASSESSMENT OF OUT-OF-THE-OPERATING ROOM ENVIRONMENT

Providing anesthesia in the non-OR setting requires flexibility and a thorough understanding of the resources that are both present and absent. **Box 2** lists examples of NORA sites. The out-of-OR environment may differ significantly from the regular flow of the OR, and it is important for anesthesiologists to familiarize themselves with the objectives, structure, and workflow of these locations. These spaces are often not built with anesthesiologists in mind. The procedure room may have limited space and a plethora of procedural equipment. Many rooms contain a procedure room with a control room used to monitor patients when radiation-based procedures are being administered. Other locations contain bulky MRI and computed tomographic machines that shield the patient from the anesthesiologist's view. Fluoroscopy suites have moveable parts that may interfere with monitoring and equipment requiring long extensions for IVs, medication lines, O<sub>2</sub> tubing, and breathing circuits. MRI suites have unique requirements for nonferrous equipment, limiting what can be brought into the procedure room. Interference with continuous monitoring from these radiology modalities can cause additional challenges in providing care to these patients.

Equipment that is often taken for granted in the OR, such as scavenging systems, oxygen/air delivery systems, or suction may not be readily available or located in unreachable areas of the room. Many anesthesiologists may have to bring portable equipment to these locations. Each piece of equipment should be identified and checked before use. Monitoring should also be visually accessible to the anesthesia

#### Box 2

#### Non-operating room anesthetizing sites

##### Radiology

- Interventional
- MRI
- Computed tomography
- Ultrasound
- Radiation oncology

##### Gastroenterology

##### Cardiac interventions

- Electrophysiology
- Catheterization
- Interventional cardiology
- Transesophageal echocardiography

##### Lithotripsy

##### Electroconvulsive therapy sites

##### Emergency room

##### Intensive care units

##### Obstetric labor and delivery

##### Hospital wards

##### Ambulatory procedure rooms

##### Outpatient offices

team. The anesthesia provider should take note of the location of the difficult airway, malignant hyperthermia, and Code Blue cardiopulmonary carts. A careful perusal of each unfamiliar location should be performed before the start of the procedure. It is important to determine where backup personnel are located and the means to reach them. A process must be established to quickly retrieve additional medications and equipment, if necessary. For example, having an automated medication dispensing cabinet located inside the procedure room can facilitate quick access to the necessary medications for the anesthesiologist and other staff. The careful planning and monitoring that has made anesthesiologists pioneers of patient safety in the OR should be adhered to, just as, if not more stringently than, one does in OR-based locations.

Other considerations during procedure site reconnaissance include the following<sup>27,28</sup>:

1. Where will the patient be induced: procedural bed, stretcher, other area?
2. Are the anesthesia equipment and O<sub>2</sub> source close enough to the patient?
3. Is it possible to monitor the patient from a further distance when hazards such as radiation require this?
4. Will additional portable monitors be necessary?
5. Does everyone in the procedure room know how to call a code and use the code cart?
6. Are all personnel aware of what constitutes an anesthetic emergency?

Performing anesthetics at NORA locations requires intense communication and teamwork. Many of the procedural staff may not be familiar with the unique requirements of anesthesia provision, which may impede workflow and cause unintended harm. Team leadership should be emphasized and a collaborative environment needs to be fostered, especially when taking care of a medically complex patient population. These patients are often referred to interventional procedures as a last resort, when more invasive procedures are not indicated or carry a higher risk. Therefore, both proceduralists and anesthesiologists can be faced with unexpected patient challenges during the procedure, requiring quick responses and teamwork. Both patient and procedural concerns should be identified to the procedural team before the initiation of the case.

Radiation safety must be a focus in the out-of-OR setting. Personnel operating in these sites are routinely exposed to radiation doses higher than what most medical personnel experience. The vast majority of occupational exposure is through fluoroscopy. Long-term complications may involve thyroid disease, skin conditions, cataracts, bone marrow suppression, and malignancy if radiosensitive cells (fast-growing, undifferentiated cells) are not protected; this involves protecting the reproductive organs, lenses of the eye, and thyroid gland. Fluoroscopy can introduce 20 times the radiation than a single exposure. Anesthesiologists who work close to the patient and the radiation beam must take care of shielding themselves. Because even with proper leaded apparel up to 18% of all active bone marrow is still exposed to the effects of radiation, it is important to protect as much body surface area as possible.<sup>29</sup> A protective panel of at least 0.25-mm lead equivalent should be positioned between the patient and all other staff. By law, no one less than the age of 18 should be allowed into the room during exposure. Lead aprons and thyroid shields that offer at least 0.5 m of lead should be worn at all times and should be checked annually for damage. Radiation beam attenuates are based on the inverse square law ( $1/d^2$ ); therefore, placing a safe distance between the radiation beam is the safest way to decrease radiation exposure.<sup>30</sup> Radiation dosimeters should be worn outside of protective clothing. Distance from the patient and radiation beam is the best form of protection.



## PREOPERATIVE PATIENT ASSESSMENT

The health assessment should begin with a careful history of patient's comorbidities. The ASA has developed a Practice Advisory for Preanesthesia Evaluation, an evidence-based guideline that outlines all aspects of preoperative assessment and testing.<sup>31</sup> Each disease condition should be explored, noting severity, exacerbating factors, and stability. Physician functional status should be assessed. Medications, including over the counter and herbal supplements, should be reviewed. Social history including substance, alcohol, and smoking use as well as a personal and/or family history of anesthetic complications should be noted. A targeted physical examination should include, at the minimum, obtaining vital signs, auscultating the heart and lung fields, abdominal examination, extremity examination, and a focused neurologic examination. Last, a thorough airway examination with a dental assessment should be completed, as outlined in **Box 3**.

### *Cardiovascular System*

Cardiopulmonary events are the most feared complications during procedures, and therefore, a thorough assessment should be performed. Although most non-OR procedures can be performed under less invasive means and do not require a general anesthetic, any anesthetic may turn into a general anesthetic and any procedure may require emergent resuscitation and transport to the OR for a surgical intervention.

#### **Box 3**

##### **Basic elements of patient assessment**

Age

Height

Weight

Allergies: reactions to allergens

Current medications, including over-the-counter medications and herbal supplements

Smoking status: how frequent, how long, and when was the last use

Illicit substance use: how frequent, how long, and when was the last use

Alcohol use: how frequent, how long, and when was the last use

Family history

Previous hospitalizations

Previous surgeries

Pregnancy status

Current medical conditions

Functional status

Focused physical examination

Airway examination

- Mouth opening
- Mallampati score
- Thyromental distance
- Dental condition
- Neck mobility
- Prior anesthesia records

According to the most recent American College of Cardiology and the American Heart Association Guidelines for cardiovascular evaluation for noncardiac surgery, the patient should be cleared for the OR based on their disease status and current condition of disease, risk factors, and the type and urgency of the procedure.<sup>32</sup> Active cardiac conditions include acute myocardial ischemia (within 7 days of onset), unstable or severe angina, decompensated heart failure, severe valvular disease, or significant arrhythmia.

## CARDIOVASCULAR ASSESSMENT

Approximately one American experiences a coronary event every 34 seconds, and coronary disease has caused approximately 1 of every 7 deaths in the United States in 2011.<sup>33</sup> The spectrum of symptoms range from asymptomatic to unstable, frequent angina, and functional impairment. Each patient's cardiovascular record should be requisitioned with prior echocardiography, electrocardiography, and stress tests. Baseline blood pressure and heart rate should be recorded, and these parameters should be maintained within 10% of baseline under anesthesia. Patients with concerning symptoms or risk factors without recent evaluation should receive an electrocardiogram, and further testing may be considered. The benefits of coronary revascularization before a procedure are controversial, and the risks need to be balanced with the risks of a procedure with significant disease burden.

Revascularized patients typically have either bare-metal or drug-eluting stents that require a period of antiplatelet therapy that may cause increased bleeding risks during procedures. Current guideline for therapy recommends at least a 1-month duration for bare-metal stents and a 6-month duration for drug-eluting stents, although the optimal period of therapy is still not completely clear.<sup>34</sup> Many patients are maintained on these medications for much longer than the officially suggested duration, and the risk of holding these medications before instrumentation needs to be considered against each patient's risk factors. For patients who are anticipating surgery, there may be discussions with the cardiology team regarding the patient's candidacy for bare-metal stents due to the shorter mandatory therapy time. Elective procedures should be postponed until this period of therapy has been reached to prevent complications. Aspirin should be continued during the perioperative period with the exception of certain procedures on closed spaces such as neurosurgical/neurologic interventional procedures. These concerns should be discussed with the procedural team. Both invasive and noninvasive procedures can increase a patient's risk of stent thrombosis, which is associated with high mortality.

Patients with congestive heart failure should be assessed for the presence of decompensation based on both symptoms and physical examination. Prior echocardiograms should be evaluated to determine anatomic dysfunction. Although systolic cardiac dysfunction is often the most worrisome type of heart failure, more than half of all heart failure incidences are caused by diastolic failure. These patients should be on salt restriction,  $\beta$ -blockers, and angiotensin-converting enzyme medications and should have a well-managed blood pressure.

Severe valvular dysfunction often manifests with symptoms of heart failure. These patients will require a thorough assessment of functional status and symptoms. With severe valvular conditions, changes in either heart rate or blood pressure may cause sudden and severe cardiac dysfunction. Maintenance of normal sinus rhythm for atrial kick, volume status, heart rate, and blood control needs to be tailored for the specific valvular abnormality. Finally, some patients may require endocarditis prophylaxis during the procedure; the latest guidelines are outline in **Box 4**.

**Box 4****Conditions requiring endocarditis prophylaxis**

Prosthetic cardiac valve or prosthetic material used for cardiac valve repair

Prior history of infective endocarditis

Congenital heart disease (CHD)

- Unrepaired cyanotic CHD
- Completely repaired CHD with prosthetic material or device during the first 6 months after the procedure
- Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device

Cardiac transplant patients who develop cardiac valvulopathy

*Adapted from Wilson W, Taubert KA, Gewitz M, et al. Prevention of infective endocarditis: guidelines from the American Heart Association: a guideline from the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee, Council on Cardiovascular Disease in the Young, and the Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and the Quality of Care and Outcomes Research Interdisciplinary Working Group. Circulation 2007;116(15):1745.*

Patients with pacemakers and implantable cardioverter-defibrillators are seen with increasing frequency in procedural rooms. Each anesthesiologist should be familiar with the setting of each pacer, the patient's condition that required its placement, and the level of their pacemaker dependence. Each patient should be queried about the frequency of defibrillation, and if there are any concerns, the pacemaker should be interrogated. Each device reacts differently to magnet placement, including some that do not revert to its original settings after magnet placement, making it even more important to understand this function. Not all procedures require the placement of a magnet, and this decision must be made on an individual basis, depending on the patient's device dependence and location of the procedure. For patients who are pacemaker-dependent, having the device changed to an asynchronous mode instead of a sensed mode by a cardiologist on the day of surgery is recommended. Magnets should only be used as a last resort during emergencies. In the devices with both pacemaker and defibrillation capabilities, magnet placement may cause variable changes in function. In many devices, only the antitachyarrhythmia function is disabled without changes to the underlying pacemaker function. Therefore, reliance on magnet placement is not recommended, and actual interrogation and disabling of functions by cardiologists should be performed. Any device that has been deactivated by a magnet should be interrogated and re-enabled before the patient leaves the recovery room.<sup>35</sup>

**PULMONARY ASSESSMENT**

Despite the focus given to perioperative cardiac complications, pulmonary complications can contribute significantly to perioperative morbidity and mortality. Hypoxia and desaturation are the most common occurrences seen in the perioperative period. Risk factors include advanced age, chronic obstructive pulmonary disease (COPD), smoking (current and prior history), heart failure, higher ASA class, impaired sensorium, functional dependency, and obstructive sleep apnea.<sup>36</sup> Surgical risk factors include upper abdominal surgeries and any abdominal surgeries, duration of procedure, general anesthesia, and emergent procedures. Elective procedures should be postponed for patients with active respiratory disease for 6 weeks to decrease the risk of

pulmonary events. Patients with asthma or COPD should be assessed for medical optimization and functional status. Although pulmonary function tests, radiographs, and arterial blood gas provide information on a patient's baseline status, these tests are not necessary to perform during the preoperative assessment and have demonstrated little benefit. Patients with severe disease and functional limitations may be candidates for regional or neuraxial anesthesia in an effort to avoid airway manipulation as well as perioperative bronchodilator therapy. Patients with sleep apnea should be instructed to bring with them their home continuous positive airway pressure devices on the day of the procedure.

### **GASTROINTESTINAL ASSESSMENT**

Patients should be evaluated for conditions causing decreased gastric motility or full stomach precautions. Severity of gastroesophageal reflux should be determined and acid suppressants should be taken on the day of the procedure. Patients with concerns for delayed gastric emptying, such as intestinal obstruction, gastroparesis, trauma, emergent procedures, full stomachs, or opioid use, should be assessed for rapid sequence inductions and the need for gastric decompression after induction. For example, although many of the diagnostic gastrointestinal endoscopies (upper endoscopy, colonoscopy) are performed while maintaining a natural airway, some of these patients may pose a higher aspiration risk.

### **RENAL ASSESSMENT**

Many non-OR procedures involve the use of fluoroscopy and IV dye, which can increase the risk of renal injury. Contrast-induced nephropathy (CIN) has been associated with up to 11% of all hospital-acquired acute renal failure. CIN is defined as a greater than 0.5 mg/dL increase in creatinine in patients with baseline creatinine less than 1.9 mg/dL occurring within 48 to 72 hours after contrast administration in the absence of other causes for renal injury.<sup>37</sup> Patients without history of renal disease have very low risk of CIN and do not require routine monitoring or prophylaxis.<sup>38,39</sup> The single most important risk factor for CIN is chronic kidney disease (serum creatinine >1.5 mg/dL), which imparts more than 20 times the risk compared with patients with normal renal function. Additional risk factors include diabetes, male gender, diabetes, volume of contrast agent, and renal impairment.<sup>40</sup> Procedures that are most commonly associated with CIN include coronary angiograms, angioplasties, and computed tomographic scans.<sup>37</sup> Strategies for prevention of CIN are outlined in [Table 1](#).

Dialysis-dependent patients should have dialysis on the day before the procedure but generally avoid dialysis on the day of procedure because of concerns for electrolyte abnormalities and volume depletion.

### **OBSTETRIC ASSESSMENT**

Pregnant patients should be assessed for the current status of their pregnancy, complications, and need for intervention. Because of the potentially devastating complications associated with pregnancy, elective procedures should be postponed until after delivery or until the second trimester. Procedures and medications administered during the first trimester coincide with fetal organogenesis and they are best avoided, while more invasive procedures during the third trimester may precipitate premature labor.<sup>42</sup> Abdominal procedures increase this risk.

All women of child-bearing age should be assessed for the possibility of pregnancy. This assessment of the possibility of pregnancy is especially important for procedures

<b>Table 1 Guidelines for prevention of contrast-induced nephropathy</b>	
Glomerular filtration rate (GFR) >60 mL/min, normal or near normal renal function	Low risk for CIN, no follow-up or prophylaxis required
GFR <45–59 mL/min	Low risk for CIN without risk factors, no specific prophylaxis or follow-up required If intra-arterial contrast is administered, preventative measures are recommended
GFR <45 mL/min	Moderate risk for CIN, preventative measure recommended
CIN prevention strategies <sup>41</sup>	IV hydration <ul style="list-style-type: none"> <li>• For inpatients, 0.9% saline solution at 1 mL/kg/h for 12 h before the procedure and 12 h after the procedure</li> <li>• For outpatients, isotonic saline or sodium bicarbonate solution at 3 mL/kg/h, a minimum of 1 h before the procedure and 6 h after the procedure is a reasonable abbreviated alternative</li> </ul> N-acetylcysteine: inconclusive results but often administered due to low cost and lack of major adverse effects Discontinue nephrotoxic medications 8 h before administration of contrast Avoid dehydration Avoid high osmolar contrast Dialysis patients do not require fluid hydration before contrast administration

*Adapted from* Nicola R, Shaqdan KW, Aran K, et al. Contrast-induced nephropathy: identifying the risks, choosing the right agent, and reviewing effective prevention and management methods. *Curr Probl Diagn Radiol* 2015;44(6):503.

that involve high levels of radiation exposure. A pregnancy test should routinely be a part of each assessment if there is any uncertainty about the woman's menstrual history.

## PROCEDURAL ASSESSMENT

Many procedures performed in the non-OR setting involve creative techniques and maneuvering to access anatomic locations that may not be amendable for surgery. A careful discussion of the planned procedure, the involved components, the need for immobility, duration, and positioning should occur among the care team members. The need for IV contrast, medications, and invasive blood pressure monitoring should be ascertained before the procedure so that preventative measures can be taken.

## DIAGNOSTIC TESTING

Diagnostic testing before each procedure must be individualized based on patient risk factors and the procedure itself. For patients without baseline laboratory tests in whom there are possible bleeding risks or renal injury risks, baseline laboratory tests assessing coagulation status, hemoglobin, and renal function should be drawn and blood typing should be obtained. Dialysis patients should have electrolyte levels drawn after their last dialysis run. Diabetics should have documented preoperative glucose levels on the day of the procedure, and glucose levels should be monitored during the procedure, depending on its duration. Patients with concerns for cardiac

<b>Table 2</b>	
<b>Perioperative medication administration</b>	
<b>Medication</b>	<b>Perioperative Administration Instruction</b>
Aspirin	Continue unless contraindicated by the procedure (ie, neurologic, ophthalmic interventions) or by the proceduralist
$\beta$ -Blockers	—
Angiotension converting enzyme inhibitors and angiotension receptor blockers	Hold 12–24 h before procedure due to concerns of causing vasoplegia
Other antihypertensives	Continue the day of surgery
Diuretics	Hold on the day of surgery
Pulmonary inhalers	Continue the day of surgery, bring to the preoperative assessment center and administer before the procedure
Gastrointestinal reflex medications	Continue on the day of surgery
Neurologic therapies (dementia, Parkinson, seizure prophylaxis)	Continue the day of surgery
Antianxiety medications	Continue on the day of procedure
Monoamine oxidase inhibitors	Continue on the day of procedure unless risk for serotonin syndrome is high and patient at low risk for rebound from discontinuation. Complete clearance requires 3 wk
Autoimmune and immunosuppressant medications	Continue the day of procedure
Steroids	Continue the day of procedure Patients using $\leq 5$ mg a day of prednisone equivalent for $\leq 3$ wk have low risk of adrenal suppression $\geq 5$ –20 mg per day of prednisone equivalent for $\geq 3$ wk may cause adrenal suppression $\geq 20$ mg/d for $\geq 3$ wk will cause adrenal suppression that may continue for a year after cessation
Insulin	Administer 1/3 to 1/2 dose the evening or morning of procedure depending on frequency of dosing. Hold short-acting insulin If insulin pump, continue lowest basal night time rate Measure blood glucose the morning of procedure. These patients should be scheduled as the first morning cases
Opioid and pain medications	Take normal morning dose before procedure Hold nonsteroidal anti-inflammatory medications 48 h before procedure
Oral antiglycemic medications	Hold on the day of surgery Hold metformin on the day of surgery, risk of lactic acidosis most prominent in renal or hepatic failure
Herbal medication and supplements	Hold for 7–14 d before procedure

disease should have an electrocardiogram, whereas further testing should be decided based on patient's symptoms. Routine preoperative tests have rarely been shown to impact patient management and improve patient care.<sup>31</sup> In fact, instances of harm have been documented due to pursuit of otherwise unknown abnormalities based on these tests. Tests should only be ordered if they will impact the care provided.<sup>11</sup>

## PREPROCEDURAL MEDICATION MANAGEMENT

The patient's current medication list should be carefully examined to make sure it is up to date, the dosages correspond to the actual amount of each medication taken, and instructions by the patient's providers, including the proceduralist, have been followed. Some medications should be continued on the day of surgery, while others should be held before the procedure, as outlined in [Table 2](#). The risk of stopping certain medications should be weighed against the risk of continuing them during the periprocedural period; this is especially true for the management of anticoagulants and antiplatelet medications.<sup>43</sup>

## FUTURE DIRECTIONS

As non-OR procedures increase in frequency and complexity, a scientific approach to triaging patients for proper selection of sedation by nonanesthesiologists or anesthesia care needs to be developed. Algorithms that identify patient and procedural risk factors that would benefit from further assessment or the presence of anesthesia staff will aid physicians in providing the best care for each patient. Ideally, risk stratification strategies can be developed that take patient, procedural, anesthesia, and location factors into consideration. National standards and protocols for non-OR anesthetics for each subspecialty and procedure will need to be further developed and evaluated against patient outcomes. The standardization of patient assessment should be a result of interdisciplinary efforts by proceduralists, anesthesiologists, nurses, and hospital administrators. Lastly, there is a need to develop financial models to demonstrate the value of NORA evaluation process and how creating an infrastructure for this process can positively impact periprocedural efficiency and patient outcomes.

## SUMMARY

As the pioneers of patient safety, anesthesiologists should strive to maintain the same standard of care throughout all anesthetizing locations. As the demand for NORA continues to increase, it is becoming more important than ever for the anesthesiologist to deliver the same standard of care that is expected in the OR. In the NORA environment, where both proceduralists and support staff may have limited knowledge of the patient's history and anesthetic needs, an increased emphasis on proper patient triaging and preoperative assessment by the anesthesia care team becomes imperative. As procedures and techniques rapidly evolve, preoperative assessments need to adapt concurrently. Oftentimes, this means that novel and unique management plans need to be tailored to each patient for each specific procedure. Communication and teamwork in these locations are equally important because many unknowns may arise due to increasingly complex techniques and comorbidities. In this exciting new era of medical advancement, anesthesiologists need to be at the forefront of promoting patient safety. In collaboration with medical specialists of all specialties, anesthesiologists are ushering in a new era of improved patient care where they can add significant value.

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