



## Anesthesia Safety

### What is anesthesia and how does it work?

Anesthesia is a state of consciousness or sedation achieved by using medications and/or non-pharmacologic adjuncts (therapy that does not involve the use of drugs), which decrease or block pain sensation of a part of or the entire body. Anesthesia may also cause full or partial amnesia so that the patient may not remember what is going on with them and around them. Anesthesia is used to increase patient comfort and safety during medical or surgical procedures.



There are four general categories of anesthesia commonly used for imaging procedures, including: local anesthesia, regional anesthesia, general anesthesia, monitored anesthesia care, and non-drug adjuncts.

#### • **Local anesthesia**

A local anesthetic is a medication that numbs the treated area. The numbness prevents or reduces pain and sensation.

Local anesthesia blocks the electrical signals (called impulses) that transfer pain sensation through sensory nerves from the targeted area of the body. Local anesthesia only affects sensation in and around the treated area. It does not affect memory, recall of events or a patient's ability to breathe on his or her own.

For short procedures, when the patient is relatively calm and can tolerate discomfort, local anesthesia may be used alone and without additional medications. Local anesthesia may also be used with other medications that can affect memory, anxiety and the ability to feel pain at areas separate from those that received the local anesthetic.

Local anesthetics may be administered in different ways, including topical anesthesia, subcutaneous and regional anesthesia.

- **Topical** anesthesia is placed on the skin surface. The skin absorbs the medication and creates

numbness where it is applied. Topical anesthesia is commonly applied to the skin surface in the form of a cream or an adhesive patch that contains the topical anesthetic. Anesthetic spray may be used to numb the lining of the nose, mouth or throat when required.

- **Subcutaneous** anesthesia is injected below the skin surface to numb the nerve fibers that otherwise would create a sensation of pain at the level of the skin and immediately below it.
- **Regional** anesthesia provides a more generalized area of numbness. Types of regional anesthesia include:
  - Epidural (extradural) anesthesia involves the injection of local anesthetics into the epidural space, an empty area containing the fluid-filled sac that protects the spinal cord. Injection of local anesthetics into the epidural space decreases the sensation of pain and touch by numbing the nerve fibers in the area of the spinal cord near the injection site. An epidural is most commonly administered to block sensation for procedures performed on areas from the waist to the toes.
  - Spinal anesthesia (subarachnoid block) involves the injection of a local anesthetic into the fluid-filled sac that protects and surrounds the spinal cord.
  - Peripheral nerve blockade involves the injection of a local anesthetic to specific areas of the body to provide temporary relief of sensation to the area.

## • General anesthesia

Under general anesthesia, the patient is unaware and does not sense pain. General anesthesia reduce the patient's ability to breathe without assistance from the anesthesiologist and often times requires the use of a breathing machine (anesthesia ventilator).

To deliver general anesthesia and to maximize patient safety, a breathing tube (endotracheal tube) or another airway device (laryngeal mask airway) may be needed. General anesthesia can be achieved with a variety of different medications administered by various methods.

The most common method to deliver general anesthesia is through inhalation after an initial intravenous (IV) injection. The patient breathes in anesthesia gases that are absorbed by the lungs and delivered via blood stream to the brain and spinal cord.

A patient who receives general anesthesia is usually under the care of an anesthesiologist, a medical doctor who has completed three years of specialized training in anesthesia beyond medical school. A nurse anesthetist is a specially trained nurse who may also administer general anesthesia, usually under the direct supervision of the anesthesiologist. Under general anesthesia, the anesthesiologist or nurse anesthetist remains with the patient throughout the procedure and carefully checks the patient's heart rate, electrocardiogram, blood pressure and oxygen delivery (pulse oximetry) at a minimum of five-minute intervals.

Patients typically have amnesia regarding what happened during general anesthesia; only rarely do some patients remember events.

## • Deep sedation/ monitored anesthesia care

Sedatives are medications that are given to reduce a patient's ability to sense and/or consciously remember pain. Sedatives are usually given intravenously through an intravenous (IV) catheter. Deep sedation may be delivered by an anesthesiologist or anesthetist, and in some cases, a qualified

non-anesthesiologist.

When deep sedation is administered by an anesthesiologist or nurse anesthetist, it is often referred to as monitored anesthesia care. Under deep sedation, a patient is normally able to breathe on his own without the assistance of a breathing machine. Deep sedation is intended to relieve pain, reduce discomfort and/or reduce the likelihood of recalling a painful procedure.

There are levels of sedation. Prior to achieving or entering deep sedation, a patient passes through minimal and moderate levels of sedation. These levels of sedation may not always be administered by an anesthesiologist. The level of sedation reflects the patient's ability to sense and respond to pain and verbal commands.

## **Minimal/Moderate Sedation**

Sedatives are medications that are given to reduce anxiety and the ability to sense and/or remember pain. Sedatives are typically given intravenously through an intravenous (IV) catheter.

The patient should respond to verbal commands or questions and will be able to respond appropriately when touched. He or she can also follow the physician's instructions. At this level of sedation, patients are able to breathe without assistance. Anesthesiologists and qualified non-anesthesiologist healthcare professionals may administer this level of sedation.

## **Which imaging exams may require anesthesia or sedation?**

Some patients undergoing imaging exams (MRI, for example) may need sedation or a general anesthetic in order to stay relaxed and lie motionless.

Sedatives or anesthesia may be offered to:

- patients who are extremely anxious, claustrophobic or who have medical conditions that make it difficult or impossible to remain motionless for the exam.
- young infants, children and adolescents who are incapable of remaining motionless and understanding directions.

Some procedures may incorporate two different types of anesthesia. For example, interventional radiology procedures, such as angiography, angioplasty, biopsies and embolization procedures, may use both a local anesthetic to numb the skin where a needle or catheter will be used, and deep sedation to help the patient stay calm and relaxed during the procedure.

## **Are there alternatives to pharmaceutical anesthesia and sedation?**

Patients who wish to reduce the amount of medication or the need for pharmaceutical sedation can benefit from non-pharmacological approaches that include guidance in relaxation, reframing of distress and use of procedure hypnosis. These methods reduce pain, anxiety and adverse events such as nausea

and medication associated side effects. These approaches can also be successfully used to help patients overcome claustrophobia during MRI examinations.

Ask your facility if non-pharmacological approaches are available. This kind of patient guidance requires a trained medical team member who uses comforting language and effective phrasing to empower patients to find the best comfort solutions while remaining able to participate in their own care.

## **How should I prepare for my imaging test or treatment with anesthesia?**

You should tell your doctor all medications that you are taking, including herbal supplements and vitamins, and if you have any allergies to food, medications or contrast materials (also known as "dye" or "x-ray dye"). You should also inform your doctor if you have any family history of problems with anesthesia or any medical conditions or recent illnesses. Your physician will want to know about any prior surgeries, as well as if you have ever had any problems or reactions to anesthetics. Your physician may advise you to stop taking aspirin, nonsteroidal anti-inflammatory drugs (NSAIDs) or other medications that you regularly take for a specified period of time before your procedure.

Prior to your procedure, your blood may be tested to assess your ability to form blood clots and to determine how your liver and kidneys are functioning.

A physical exam and other tests also may be performed.

Women should always inform their physician or technologist if there is any possibility that they are pregnant or if they are breastfeeding their baby. See the Safety page for more information about pregnancy, breastfeeding and imaging.

You will usually be asked not to eat or drink anything for up to eight hours before receiving sedation or anesthesia, although at some institutions you may be allowed to have a few sips of a drink prior to the examination. The time period for fasting may differ based on the procedure, medical history, a patient's age, the hospital, or institution guidelines.

You may be asked to remove some or all of your clothes and to wear a gown during the exam. You may also be asked to remove jewelry, eye glasses, dentures, and any metal objects or clothing that might interfere with the x-ray images.

You must arrange to have a relative or friend drive you home after your procedure if you received pharmacologic sedation or general anesthesia. For some time (up to 24 hours) after you receive sedatives or anesthesia, your memory may be impaired and your ability to concentrate, make important decisions and operate machinery (such as a car) will be compromised.

## **How safe is anesthesia?**

In general, anesthesia and sedation are safe for most patients.

Patients are closely monitored under the direct, continuous care of an anesthesiologist or non-anesthesiologist, regardless of the level of sedation or anesthesia they have received.

## Side effects and adverse and allergic reactions

Serious side effects and allergic reactions resulting from anesthesia are rare.

Following sedation or general anesthesia, some patients may experience side effects such as nausea, vomiting, dizziness, headache, sore throat, blood pressure changes and pain. These side effects are usually mild, short-lived and treatable.

Some patients, both adults and children, may not achieve adequate sedation and pain relief with sedative administration and may require a procedure to be rescheduled with general anesthesia.

More serious complications from anesthesia are rare and are more likely to occur in patients with complex, serious medical conditions.

## What will I experience during and after the procedure?

### During the procedure

All patients who receive anesthesia are attached to specialized devices that monitor heart rate and other vital functions of the body. If you receive a general anesthetic, you will be unconscious for the entire procedure under the direct care of an anesthesia professional.

If you are scheduled to receive sedation, sedatives will usually be administered through an intravenous (IV) catheter. You may feel slight pressure or a sharp pinch when the catheter is inserted, but you should not experience any serious discomfort.

### After the procedure

If you have received a local anesthetic with or without minimal or moderate sedation, you should be able to go home soon after the procedure (up to a few hours after the procedure ends depending on the type of procedure). If you have received deep sedation or general anesthesia, you will remain in the recovery room for a longer period of time, until you have reached your normal level of consciousness.

It may take up to 24 hours for the medication to completely leave your body. You may feel tired. Following an anesthetic or sedation, you should not drive, operate equipment or make important decisions for at least 24 hours.

Children have varied responses to sedatives and anesthesia. Some children may become agitated, inconsolable or restless during or after sedation. Other children may continue to be sleepy and unsteady on their feet for the remainder of the day.

Most pediatric patients are able to resume their normal activity within six to eight hours. However, children should be monitored by a responsible adult for 12 to 24 hours after being sedated. Activities that

require coordination and balance, such as swimming, climbing and riding a bike, should usually be delayed by 24 hours.

## Pregnancy and anesthesia

Prior to any imaging exam, women should always inform their physician or x-ray technologist if there is any possibility that they are pregnant. Many imaging tests are not performed during pregnancy unless they are medically necessary and cannot be safely delayed until after pregnancy.

If anesthesia or sedation is required during pregnancy, efforts are made to avoid the delivery of medications that could adversely affect the mother or unborn baby. Women who worry whether surgery and anesthesia are safe during pregnancy should consult their obstetrician, surgeon and anesthesiologist.

Women who are breastfeeding should consult their physician before taking any medications that may be passed through breast milk. See the Safety page for more information about pregnancy, breastfeeding and imaging.

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