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Anesthesia – A Review

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Abstract
Anesthesia is the use of medicine to prevent the feeling of pain or another sensation during surgery or other procedures that might be painful. Given as an injection or through inhaled gases or vapors, different types of anesthesia affect the nervous system in various ways by blocking nerve impulses and, therefore, pain. In today's hospitals and surgery centers, highly trained professionals use a wide variety of safe, modern medications and extremely capable monitoring technology. An anesthesiologist is a doctor who specializes in giving and managing anesthetics — the medications that numb an area of the body or help you fall and stay asleep.

Keywords
Unconsciousness, pain relief, nerve block, intravenous, monitoring

INTRODUCTION

Anesthesia is a temporary state consisting of unconsciousness, loss of memory, lack of pain, and muscle relaxation. Anesthesia is a unique medical intervention which does not itself offer any particular medical benefit and instead enables the performance of other medical interventions. The best anesthetic is therefore one with the lowest risk to the patient that still achieves the end points required to complete the other intervention. The first public demonstration of general anesthesia was in 1846 by a Boston dentist named William T.G. Morton at the Massachusetts General Hospital. Dr. Morton gave an ether anesthetic for the removal of a neck tumor by surgeon John Collins Warren. About a decade later, cocaine was introduced as the first viable local anesthetic. It wasn't until the 1930s that Dr. Harvey Cushing tied the stress response to higher mortality rates and began using local anesthetic for hernia repairs in addition to general anesthesia. [1]

MEDICAL USES

The purpose of anesthesia can be distilled down to three basic goals or end points

1. hypnosis (a temporary loss of consciousness and with it a loss of memory)
2. analgesia (lack of sensation which also blunts autonomic reflexes)
3. muscle relaxation

Different types of anesthesia affect the endpoints in different ways.[2] Regional anesthesia, for instance affects analgesia, benzodiazepine type sedatives favor amnesia and general anesthetics can affect all of the endpoints. The goal of anesthesia is to achieve the necessary endpoints with the least amount of risk possible to the patient. To achieve the goals of anesthesia, drugs act on different but interconnected parts of the nervous system. Hypnosis, for instance, is generating through actions on the nuclei in the brain and is similar to the activation of sleep. The effect is to make people less aware and less reactive to non-noxious stimuli. Loss of memory is created by action of drugs on specific multiple regions of the brain. Memories are created as either declarative or non-declarative memories in several stages (short-term, long-term, long-lasting) the strength of which is determined by the strength of connections between neurons termed synaptic plasticity.[3] Each anesthetic produces amnesia through unique effects on memory formation at variable doses. Inhalational anesthetics will reliably produce amnesia through general suppression of the nuclei at doses below those required for loss of consciousness. Drugs like midazolam produce amnesia through different pathways by blocking the formation of long-term memories. Tied closely to the concepts of amnesia and hypnosis is the concept of consciousness. Consciousness is the higher order process that synthesizes information. A person can have dreams (a state of subjective consciousness) during anesthetic or have consciousness of the procedure despite having no indication of it under anesthetic. It is estimated that 22% of people dream during general anesthesia and 1 or 2 cases per 1000 have some consciousness termed “awareness during general anesthesia”. [4][5]

TYPES OF ANESTHESIA

The types of anesthesia are broadly classified into general anesthesia, sedation and regional anesthesia. General anesthesia refers to the suppression of activity in the central nervous system, resulting inunconsciousness and total lack of sensation. Sedation or dissociative anesthesia uses agents that inhibit transmission of nerve impulses between higher and lower centers of the brain inhibiting anxiety and the creation of long-term memories. Regional anesthesia renders a larger area of the body insensate by blocking transmission of nerve impulses between a part of the body and the spinal cord. It is divided into peripheral and central blockades. Peripheral blockade inhibits sensory perception within a specific location on the body, such as when a tooth is "numbed" or when a nerve block is given to stop sensation from an entire limb. Central blockades place the local anesthetic around the spinal cord removing sensation to any area below the level of the block. [5][6]

GENERAL ANESTHESIA

Anesthesia is the combination of the endpoints which are reached by drugs acting on different but overlapping sites in the central nervous system. General anesthesia has three

main goals: lack of movement (paralysis), unconsciousness, and blunting of the stress response. In the early days of anesthesia, anesthetics could reliably achieve the first two, allowing surgeons to perform necessary procedures, but many patients died because the extremes of blood pressure and pulse caused by the surgical insult were ultimately harmful[7]. Eventually, the need for blunting of the surgical stress response was identified by Harvey Cushing, who injected local anesthetic prior to hernia repairs. General anesthesia acts primarily on the brain and central nervous system to make the patient unconscious and unaware. It is administered via the patient's circulatory system by a combination of inhaled gas and injected drugs. After the initial injection, anesthesia is maintained with inhaled gas anesthetics and additional drugs through an intravenous line (IV). [8][9] In the 1930s, physicians started to augment inhaled general anesthetics with intravenous general anesthetics. The drugs used in combination offered a better risk profile to the person under anesthetic and a quicker recovery. A combination of drugs was later shown to result in lower odds of dying in the first 7 days after anesthetic. For instance, propofol (injection) might be used to start the anesthetic, fentanyl (injection) used to blunt the stress response, midazolam (injection) given to ensure amnesia andsevoflurane (inhaled) during the procedure to maintain the effects. [9] More recently, several intravenous drugs have been developed which, if desired, allow inhaled general anesthetics to be avoided completely. The core instrument in an inhalational anesthetic delivery system is an anesthetic machine. It has vaporizers, ventilators, an anesthetic breathing circuit, waste gas scavenging system and pressure gauges. The purpose of the anesthetic machine is to provide anesthetic gas at a constant pressure, oxygen for breathing and to remove carbon dioxide or other waste anesthetic gases. Since inhalational aenesthetics are inflammable, various checklists have been developed to confirm that the machine is ready for use, that the safety features are active and the electrical hazards are removed. Intravenous anesthetic is delivered either by bolus doses or an infusion pump. There are also many smaller instruments used in airway management and monitoring the patient. The common thread to modern machinery in this field is the use of fail-safe systems that decrease the odds of catastrophic misuse of the machine. [10]

SEDATION

Sedation
creates hypnotic, sedative, anxiolytic, amnesic, anticonvuls ant, and centrally produced muscle-relaxing properties. From the perspective of the person giving the sedation, the patient will appear sleepy, relaxed and forgetful, allowing unpleasant procedures to be more easily completed. Sedatives such as benzodiazepines are usually given with pain relievers (such as narcotics, or local anesthetics or both) because they don't, by themselves, provide significant pain relief. From the perspective of the person receiving sedative, the effect is a feeling of general relaxation, forgetfulness and time passing quickly. Many drugs can produce a sedative effect including benzodiazepines, propofol,
thiopental, ketamine and inhaled general anesthetics. The advantage of sedation over a general anesethetic is that it generally doesn't require support of the airway or breathing (no tracheal intubation or mechanical ventilation) and can have less of an effect on the cardiovascular system which may add to a greater margin of safety in some patients. [11]

LOCAL ANESTHESIA

Local anesthesia is medicine given to temporarily stop the sense of pain in a particular area of the body. A patient remains conscious during a local anesthetic. For minor surgery, a local anesthetic can be administered via injection to the site. However, when a large area needs to be numbed, or if a local anesthetic injection will not penetrate deep enough, physicians may resort to regional anesthetics. [11][12]

REGIONAL ANESTHESIA

Regional anesthesia involves injection of a local anesthetic (numbing agent) around major nerves or the spinal cord to block pain from a larger but still limited part of the body. You will likely receive medicine to help you relax or sleep during surgery. There are many types of regional anesthesia either by injecting into the tissue itself, a vein that feeds the area or around a nerve trunk that supplies sensation to the area. The later are called nerve blocks and are divided into peripheral or central nerve blocks.[13]
The following are the types of regional anesthesia:

- Infiltrative anesthesia: a small amount of local anesthetic is injected in a small area to stop any sensation (such as during the closure of a laceration, as a continuous infusion or "freezing" a tooth). The effect is almost immediate.
- Peripheral nerve block: local anesthetic is injected near a nerve that provides sensation to particular portion of the body. There is significant variation in the speed of onset and duration of anesthesia depending on the potency of the drug (e.g. Mandibular block).
- Intravenous regional anesthesia (also called a Bier block): dilute local anesthetic is infused to a limb through a vein with a tourniquet placed to prevent the drug from diffusing out of the limb.
- Central nerve blockade: Local anesthetic is injected or infused in or around a portion of the central nervous system (discussed in more detail below in Spinal, epidural and caudal anesthesia).
- Topical anesthesia: local anesthetics that are specially formulated to diffuse through the mucous membranes or skin to give a thin layer of analgesia to an area (e.g. EMLA patches).
- Tumescent anesthesia: a large amount of very dilute local anesthetics are injected into the subcutaneous tissues during liposuction.
- Systemic local anesthetics: local anesthetics are given systemically (orally or intravenous) to relieve neuropathic pain.
- Spinal - often used for lower abdominal, pelvic, rectal, or lower extremity surgery. This type of anesthetic involves injecting a single dose of the anesthetic agent

directly into the spinal cord in the lower back, causing numbness in the lower body.

- Epidural, and caudal anesthesia - this anesthetic is similar to a spinal anesthetic and also is commonly used for surgery of the lower limbs and during labor and childbirth. This type of anesthesia involves continually infusing drugs through a thin catheter that has been placed into the space that surrounds the spinal cord in the lower back, causing numbness in the lower body.

RISKS AND COMPLICATIONS

Anaphylaxis can occur to any anaesthetic agent and in all types of anaesthesia.[1] The severity of the reaction may vary but features may include rash, urticaria, bronchospasm, hypotension, angio-oedema, and vomiting. It needs to be carefully looked for in the pre-operative assessment and previous general anaesthetic charts may help. A reduced level of consciousness can lead to an unprotected airway. If the patient vomits they can aspirate the vomitus contents into their lungs. This can set up lung inflammation with infection. The risk of aspiration pneumonitis and aspiration pneumonia is reduced by fasting for several hours prior to the procedure and cricoid cartilage pressure during induction of anaesthesia. However, the evidence for the use of cricoid pressure is not clearly documented and further investigation is required. Aspiration pneumonitis may also occur in spinal anaesthesia if the level of spinal block is too high, leading to paralysis or impairment of the vocal cords and respiratory impairment. Peripheral nerve damage can occur with all the types of anaesthesia and results from nerve compression. The most common cause is exaggerated positioning for prolonged periods of time. Both the anaesthetist and the surgeons should be aware of this potential complication and patients should be moved on a regular basis if possible. The severity varies and recovery may be prolonged. The most common nerves affected are the ulnar nerve and the common peroneal nerve. More rarely, the brachial plexus may be affected. Injury to nerves can be avoided by prevention of extreme postures for lengthy periods during surgery. If nerve damage occurs then patients should be followed up and further investigations such as electromyography may be required. Air embolism occurs more commonly during neurosurgical procedures or pelvic operations. Prophylaxis of thromboembolism is common and begins pre-operatively with thromboembolic deterrents (TEDS) and low molecular weight heparin (LMWH). [13][14][15]

CONCLUSION

General anesthesia is very safe. However, as you have learned, there are some risks and possible complications. Let your doctors know of any new symptoms that you may have after your surgery. Most of the complications can be prevented through good communication. Make sure to inform your doctors and anesthesia team of all your medical conditions, medications, allergies and previous anesthetics. There are both major and minor risks of anesthesia. Examples of major risks include death, heart attack and pulmonary embolism whereas minor risks can include postoperative nausea and vomiting and readmission to hospital. The likelihood of a complication occurring is proportional to the relative risk of a variety of factors related to the patient's health, the complexity of the surgery being performed and the type of anesthetic. Of these factors, the person's health prior to surgery (stratified by the ASA physical status classification system) has the greatest bearing on the probability of a complication occurring. Patients typically wake within minutes of an anesthetic being terminated and regain their senses within hours. One exception is a condition called long-term post-operative cognitive dysfunction, characterized by persistent confusion lasting weeks or months, which is more common in those undergoing cardiac surgery and in the elderly. Anesthesia , given to patients to inhibit pain, sedates the body and also regulates various bodily functions in surgery and benefits the operator as well as the patient.

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