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GENERAL ANESTHESIA AND ITS COMPLICATIONS

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ABSTRACT

General anesthesia is a combination of medications that put you in a sleep-like state before a surgery or other medical procedure. Under general anesthesia, you don't feel pain because you're completely unconscious. General anesthesia usually uses a combination of intravenous drugs and inhaled gasses (anesthetics). An anesthesiologist is a specially trained doctor who specializes in anesthesia. While you're under anesthesia, the anesthesiologist monitors your body's vital functions and manages your breathing. In many hospitals, an anesthesiologist and a certified registered nurse anesthetist (CRNA) work together during your procedure. Your anesthesiologist or nurse anesthetist, along with your doctor, will recommend the best anesthesia option for you based on the type of surgery you are having, your overall health and your individual preferences. For certain procedures, your team may recommend general anesthesia

INTRODUCTION:

General anaesthetics (GAs) are drugs which produce reversible loss of all sensation and consciousness.

The cardinal features of general anaesthesia are:

- Loss of all sensation, especially pain
- Sleep (unconsciousness) and amnesia
- Immobility and muscle relaxation
- Abolition of somatic and autonomic reflexes.

HISTORY:

Before the middle of 19th century a number of agents like alcohol, opium, cannabis, or even concussion and asphyxia were used to obtund surgical pain, but operations were horrible ordeals. Horace Wells, a dentist, picked up the idea of using nitrous oxide (N2O) from a demonstration of laughing gas in 1844. However, he often failed to relieve dental pain completely and the use of N2O had to wait till other advances were made. Morton, a dentist and

Medical student at Boston, after experimenting on animals, gave a demonstration of ether anaesthesia in 1846, and it soon became very popular. Chloroform was used by Simpson in Britain for obstetrical purpose in 1847, and despite its toxic potential, it became a very popular surgical anaesthetic. Cyclopropane was introduced in 1929, but the new generation of anaesthetics was heralded by halothane in 1956. The first i.v. anaesthetic thiopentone was introduced in 1935.

MECHANISM OF ACTION:

The ligand gated ion channels (but not voltage sensitive ion channels) are the major targets of anaesthetic action. The GABAA receptor gated Cl^- channel is the most important of these. Many inhalational anaesthetics, barbiturates, benzodiazepines

and propofol potentiate the action of inhibitory transmitter GABA to open Cl^- channels. Each of the above anaesthetics appears to interact with its own specific binding site on the GABAA receptor-Cl^- channel complex, but none binds to the GABA binding site as such; though some inhaled anaesthetics and barbiturates (but not benzodiazepines) can directly activate Cl– channels. Action of glycine (another inhibitory transmitter which also activates Cl^- channels) in the spinal cord and medulla is augmented by barbiturates, propofol and many inhalational anaesthetics. This action may block responsiveness to painful stimuli resulting in immobility of the anaesthetic state. Certain fluorinated anaesthetics and barbiturates, in addition, inhibit the neuronal cation channel gated by nicotinic cholinergic receptor which may mediate analgesia and amnesia

CLASSIFICATION

Inhalational

Gas	*Volatile liquids*
Nitrous oxide	Ether
	Halothane
	Enflurane
	Isoflurane
	Desflurane
	Sevoflurane

Intravenous

Inducing agents	*Slower acting drugs*
Thiopentone sod.	*Benzodiazepines*
Methohexitone sod.	Diazepam
Propofol	Lorazepam
Etomidate	Midazolam
	Dissociative anaesthesia
	Ketamine
	Opioid analgesia
	Fentanyl

Cyclopropane, trichloroethylene and methoxyflurane are no longer used.

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STAGES OF ANAESTHESIA:

Guedel's classification, designed by Arthur Ernest Guedel in 1937, describes the four stages of anesthesia. Modern anesthetics and updated delivery methods have improved the speed of onset, general safety, and recovery, but the four stages remain essentially the same:

Stage 1 or induction: This phase occurs between the administration of the drug and the loss of consciousness. The patient moves from analgesia without amnesia to analgesia with amnesia

Stage 2 or excitement stage: The period following a loss of consciousness, characterized by excited and delirious activity. Breathing and heart rate becomes erratic, and nausea, pupil dilation, and breath-holding might occur.

Because of irregular breathing and a risk of vomiting, there is a danger of choking. Modern, fast-acting drugs aim to limit the time spent in stage 2 of anesthesia

Stage 3 or surgical anesthesia: Muscles relax, vomiting stops and breathing is depressed. Eye movements slow and then cease. The patient is ready to be operated on. This has been divided into 4 planes which may be distinguished as:

- Plane 1: Roving eyeballs. This plane ends when eyes become fixed.
- Plane 2: Loss of corneal and laryngeal reflexes.
- Plane 3: Pupil starts dilating and light reflex is lost.

- Plane4:Intercostal paralysis, shallow, abdominal respiration, dilated pupil.

Stage 4 or overdose: Too much medication has been administered, leading to brain stem or medullary suppression. This results in respiratory and cardiovascular collapse.

The anesthetist's priority is to take the patient to stage 3 of anesthesia as quickly as possible and keep them there for the duration of the surgery.

COMPLICATIONS OF GENERAL ANAESTHESIA

DURING ANAESTHESIA

1. Respiratory depression and hypercarbia
2. Salivation, respiratory secretions—less now as nonirritant anaesthetics are mostly used.
3. Cardiac arrhythmias, asystole.
4. Fall in BP
5. Aspiration of gastric contents: acid pneumonitis.
6. Laryngospasm and asphyxia.
7. Awareness: dreadful perception and recall of events during surgery—by use of light anaesthesia + analgesics and muscle relaxants
8. Delirium, convulsions and other excitatory effects are generally seen with i.v. anaesthetics—especially if phenothiazines or Drugs Acting on Central Nervous System
9. Fire and explosion—rare now due to use of non-inflammable agents.

B. AFTER ANAESTHESIA

1. Nausea and vomiting
2. Persisting sedation: impaired psychomotor function.
3. Pneumonia, atelectasis.
4. Organ toxicities: liver, kidney damage
5. Nerve palsies—due to faulty positioning.
6. Emergence delirium.
7. Cognitive defects: prolonged excess cognitive decline has been observed in some patients, especially the elderly, who have undergone general anaesthesia, particularly of long duration.

However, though rare, there are some more serious risks to be aware of:

Postoperative delirium or cognitive dysfunction – A condition called postoperative cognitive dysfunction can result in long-term memory and learning problems in certain patients. It's more common in older people because an aging brain doesn't recover from anesthesia as easily. In addition to the elderly, people who have conditions such as heart disease, especially congestive heart failure, Parkinson's disease or Alzheimer's disease, or who have had a stroke before are also more at risk. It's important to tell the physician anesthesiologist if you have any of these conditions.

Malignant hyperthermia – Some people inherit this serious, potentially deadly reaction to anesthesia that can occur during surgery, causing a quick fever and muscle contractions. If you or any family member has ever had heat stroke or suffered from malignant hyperthermia during a previous surgery, be sure to tell the physician anesthesiologist.

Breathing problems during and after surgery – Anesthesia can be more dangerous for patients who have obstructive sleep apnea, a condition that causes them to stop breathing while they sleep. In patients with this condition, anesthesia can cause the throat to close up during surgery and make it more difficult to regain consciousness and take a breath after surgery.

Some specific conditions increase the risk to the patient undergoing general anesthetic

- obstructive sleep apnea
- seizures
- existing heart, kidney or lung conditions
- high blood pressure
- alcoholism
- smoking
- history of reactions to anesthesia
- medications that can increase bleeding – aspirin
- drug allergies

- diabetes
- obesity or overweight

Death as a result of general anesthetic does occur, but only very rarely – roughly 1 in every 100,000 to 200,000.

PREANAESTHETIC MEDICATION

Preanaesthetic medication refers to the use of drugs before anaesthesia to make it more pleasant and safe. The aims are:

1. Relief of anxiety and apprehension preoperatively and to facilitate smooth induction.
2. Amnesia for pre- and postoperative events.
3. Supplement analgesic action of anaesthetics and potentiate them so that less anaesthetic is needed.
4. Decrease secretions and vagal stimulation caused by anaesthetics.
5. Antiemetic effect extending to the postoperative period.
6. Decrease acidity and volume of gastric juice so that it is less damaging if aspirated.

Different drugs achieve different purposes. One or more drugs may be used in a patient depending on the needs.

1. Sedative-antianxiety drugs

Benzodiazepines like diazepam (5–10 mg oral) or lorazepam (2 mg or 0.05 mg/kg i.m. 1 hour before) have become popular drugs for preanaesthetic medication because they produce tranquility and smoothen induction; there is loss of recall of perioperative events (especially with lorazepam) with little respiratory depression or accentuation of postoperative vomiting. They counteract CNS toxicity of local anaesthetics and are being used along with pethidine/fentanyl for a variety of minor surgical and endoscopic procedures. Midazolam is a good amnesic with potent and shorter lasting action; it is also better suited for i.v. injection, due to water solubility. Promethazine (50 mg i.m.) is an antihistaminic with sedative, antiemetic and anticholinergic properties. It causes little respiratory depression.

2. Opioids

Morphine (10 mg) or pethidine (50–100 mg), i.m. allay anxiety and apprehension of the operation, produce pre- and postoperative analgesia, smoothen induction, reduce the dose of anaesthetic required and supplement poor analgesic (thiopentone, halothane) or weak anaesthetics (N2O). Postoperative restlessness is also reduced. Disadvantages they depress respiration, interfere with pupillary signs of anaesthesia, may cause fall in BP during anaesthesia, can precipitate asthma and tend to delay recovery. Other disadvantages are lack of amnesia, flushing, delayed gastric emptying and biliary spasm. Some patients experience dysphoria. Morphine particularly contributes to postoperative constipation, vomiting and urinary retention. Tachycardia sometimes occurs when pethidine has been used. Use of opioids is now mostly restricted to those having preoperative pain. When indicated, fentanyl is mostly injected i.v. just before induction.

3. Anticholinergics

Atropine or hyoscine (0.6 mg i.m./i.v.) have been used, primarily to reduce salivary and bronchial secretions. Need for their use is now less compelling because of the increasing employment of non-irritant anaesthetics. However, they must be given before hand when ether is used. The main aim of their use now is to prevent vagal bradycardia and hypotension (which occur reflexly due to certain surgical procedures), and prophylaxis of laryngospasm which is precipitated by respiratory secretions. Hyoscine, in addition, produces amnesia and antiemetic effect, but tends to delay recovery. Some patients get disoriented; emergence delirium is more common. They dilate pupils, abolish the pupillary signs and increase chances of gastric reflux by decreasing tone of lower esophageal sphincter (LES). They should not be used in febrile patients. Dryness of mouth in the pre- and postoperative period may be distressing. Glycopyrrolate (0.1–0.3 mg i.m.) is a longer acting quaternary atropine substitute. It is a potent antisecretory and antibradycardiac drug; acts rapidly and is less likely to produce central effects.

4. Neuroleptics

Chlorpromazine (25 mg), triflupromazine (10 mg) or haloperidol (2–4 mg) i.m. are infrequently used in premedication. They allay anxiety, smoothen induction and have antiemetic action. However, they potentiate respiratory depression and hypotension caused by the anaesthetics and delay recovery. Involuntary movements and muscle dystonias can occur, especially in children.

5. H2 blockers

Patients undergoing prolonged operations, caesarian section and obese patients are at increased risk of gastric regurgitation and aspiration pneumonia. Ranitidine (150 mg) or famotidine (20 mg) given night before and in the morning benefit by raising pH of gastric juice; may also reduce its volume and thus chances of regurgitation. Prevention of stress ulcers is another advantage. They are now routinely used before prolonged surgery. The proton pump inhibitor omeprazole/ pantoprazole is an alternative.

6. Antiemetics

Metoclopramide 10–20 mg i.m. preoperatively is effective in reducing postoperative vomiting. By enhancing gastric emptying and tone of LES, it reduces the chances of reflux and its aspiration. Extrapyramidal effects and motor restlessness can occur. Combined use of metoclopramide and H2 blockers is more effective. Domperidone is nearly as effective and does not produce extrapyramidal side effects. After its success in cancer chemotherapy induced vomiting, the selective 5-HT3 blocker Ondansetron (4–8 mg i.v.) has been found highly effective in reducing the incidence of post anaesthetic nausea and vomiting as well

PRE-SURGICAL EVALUATION

Before general anesthesia is administered, patients will have a pre-surgery assessment to determine the most appropriate drugs to use, the quantities of those drugs and in which combination.

Some of the factors to be explored in a pre-surgical evaluation include:

- body mass index (BMI)
- medical history
- age
- current medications
- fasting time
- alcohol or drug intake
- pharmaceutical drug use
- mouth, dental and airway inspection
- observation of neck flexibility and head extension

How Does General Anesthetic Work?

The exact mechanisms that conspire to produce the state of general anesthesia are not well known. The general theory is that their action is induced by altering the activity of membrane proteins in the neuronal membrane, possibly by making certain proteins expand.

of all the drugs used in medicine, general anesthetics are an unusual case. Rather than a single molecule acting at a single site to produce a response, there is a huge variety of compounds, all of which generating quite similar but widespread effects, including analgesia, amnesia, and immobility.

General anesthetics are known to act at a number of sites within the central nervous system (CNS). The importance of these sites on the induction of anesthesia is not fully understood but they include:

- **Cerebral cortex:** The brain's outer layer involved in tasks relating to memory, attention, perception among other functions
- **Thalamus:** Its roles include relaying information from the senses to the cerebral cortex and regulating sleep, wakefulness, and consciousness.
- **Reticular activating system:** Important in regulating sleep-wake cycles
- **Spinal cord:** Passes information from the brain to the body and vice versa. It also houses circuitry that controls reflexes and other motor patterns.

A number of different neurotransmitters and receptors are also known to be involved in general anesthesia:

***N*-Methyl-D-aspartic acid (NMDA) receptors:** some general anesthetics bind to NMDA receptors, including ketamine and nitrous oxide (N_2O). They are known to be

important in controlling synaptic plasticity and memory functions

5-hydroxytryptamine (5-HT) receptors: normally activated by the neurotransmitter serotonin, they play a part in controlling the release of a number of other neurotransmitters and hormones

- **Glycine receptor:** glycine can act as a neurotransmitter and has a number of roles. It has been shown to improve sleep quality Trusted Source.

How to prepare the patient

- General anesthesia relaxes the muscles in your digestive tract and airway that keep food and acid from passing from your stomach into your lungs. Always follow your doctor's instructions about avoiding food and drink before surgery.
- Fasting is usually necessary starting about six hours before your surgery. You may be able to drink clear fluids until a few hours prior.
- Your doctor may tell you to take some of your regular medications with a small sip of water during your fasting time. Discuss your medications with your doctor.
- You may need to avoid some medications, such as aspirin and some other over-the-counter blood thinners, for at least a week before your procedure. These medications may cause complications during surgery.
- Some vitamins and herbal remedies, such as ginseng, garlic, Ginkgo biloba, kava and others, may cause complications during surgery. Discuss the types of dietary supplements you take with your doctor before your surgery.
- If you have diabetes, talk with your doctor about any changes to your medications during the fasting period. Usually you won't take oral diabetes medication the morning of your surgery. If you take insulin, your doctor may recommend a reduced dose.
- If you have sleep apnea, discuss your condition with your doctor. The anesthesiologist or anesthetist will need to carefully monitor your breathing during and after your surgery.

BEFORE THE PROCEDURE

Before you undergo general anesthesia, your anesthesiologist will talk with you and may ask questions about:

- Your health history
- Your prescription medications, over-the-counter medications and herbal supplements
- Allergies
- Your past experiences with anesthesia

This will help your anesthesiologist choose the medications that will be the safest for you.

DURING THE PROCEDURE

Your anesthesiologist usually delivers the anesthesia medications through an intravenous line in your arm. Sometimes you may be given a gas that you breathe from a mask. Children may prefer to go to sleep with a mask. Once you're asleep, the anesthesiologist may insert a tube into your mouth and down your windpipe. The tube ensures that you get enough oxygen and protects your lungs from blood or other fluids, such as stomach fluids. You'll be given muscle relaxants before doctors insert the tube to relax the muscles in your windpipe. Your doctor may use other options, such as a laryngeal airway mask, to help manage your breathing during surgery.

Someone from the anesthesia care team monitors you continuously while you sleep. He or she will adjust your medications, breathing, temperature, fluids and blood pressure as needed. Any issues that occur during the surgery are corrected with additional medications, fluids and, sometimes, blood transfusions.

AFTER THE PROCEDURE

When the surgery is complete, the anesthesiologist reverses the medications to wake you up. You'll slowly wake either in the operating room or the recovery room. You'll probably feel groggy and a little

confused when you first wake. You may experience common side effects such as:

- Nausea
- Vomiting
- Dry mouth
- Sore throat
- Muscle aches
- Itching
- Shivering
- Sleepiness
- Mild hoarseness

CONCLUSION:

Although general anesthetics hold many mysteries, they are hugely important in surgery and the field of medicine at large. Surgery and anesthesia are safer today than ever before, thanks to continuing advances in science. But this doesn't mean there is zero risk. In fact, surgery and anesthesia are inherently dangerous, and as with any medication or procedure, there is always the chance that something can go wrong. Certain patients are more likely to experience problems or complications and possibly even death than others because of their age, medical conditions or the type of surgery they're having. If you're planning to have surgery, there are ways to lower your risk, including meeting with your physician anesthesiologist. A physician anesthesiologist is a medical doctor who specializes in anesthesia, pain management and critical care medicine. This medical expert is responsible for planning your anesthesia care, administering the anesthesia and monitoring you during surgery. To do this effectively, the physician anesthesiologist will conduct a health assessment before your surgery to learn about any medical conditions you may have, medications you use, your other health habits and your past experience with anesthesia. Having all this information will help the physician anesthesiologist keep you safe. Anaesthesia-related complications could have been avoided in most of the cases through good prophylaxis.

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