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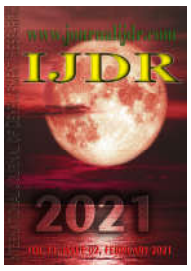

RESEARCH ARTICLE OPEN ACCESS

REVIEW OF GENERAL ANESTHESIA

***Haidar Mohammed Alshamrani**

Anesthesia Technician, Sharorah, Saudi Arabia

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****Corresponding author:***
Haidar Mohammed Alshamrani

ABSTRACT

The focus of this paper is on the review of aspects of general anesthesia such as the commonly used medications, advantages and disadvantages, and indications and contraindications of general anesthesia.The commonly used anesthetic medications are inhalational gases such as sevoflurane and desflurane and intravenous agents such as propofol and ketamine. The medications have advantages of rapid induction, ease of use and reversal. However, general anesthesia carries the risk of prolonged memory loss and reactions of the body to the drugs. The main indications are complex surgical procedures and management of refractory status epilepticus. The theater staff should be cautious of the relative contraindications of general anesthesia such as heart disease, uncontrolled medical conditions, and cardiovascular impairments.

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INTRODUCTION

General anesthesia is a physiological state of the human body characterized by loss of consciousness, analgesia, amnesia, and muscle relaxation with minimal motor responses to pain (Brown et al., 2018).The components induced by general anesthesia are reversible after a period of time subject to stoppage of administration of the general anesthetic medications or application of reversal agents. The aim of general anesthesia is to achieve optimal pain control during a surgical or medical procedure while enabling the patient to forget the circumstances surrounding the event and loss of reflexes to prevent destruction of the operator by random movement of the patient (Brown et al., 2018). Therefore, general anesthesia is a fundamental aspect of healthcare which uses different sets of medications, and it comes with merits and demerits as well as contraindications as discussed in the subsequent sections of this paper.

Commonly Used Anesthesia Medications: General anesthetic medications are categorized based on their physicochemical properties and routes of administration. The two categories of drugs used for general anesthesia are inhalational gases and intravenous agents, and their use in anesthesiology involves combination of the two groups to achieve optimal response (Mahmoud and Mason, 2018).The combination of the commonly used anesthesia medications is able to render patients unconscious, control autonomic reflexes, and make the patients numb to any painful stimuli during a procedure.

Figure 1 above shows how anesthesia medications achieve their actions by binding GABA receptors as their target. The binding leads to an influx of chloride ions which activates the inhibitory effects of GABA leading to elimination of transmission of nervous impulses (Sahinovic et al., 2018).

Intravenous Agents: This category of anesthetic medications are commonly used for induction just before conducting a procedure on the patient. In this case, induction defines the rapid transition from a conscious state to the mental state when all the four components of general anesthesia are achieved. The drugs commonly injected by the intravenous route to achieve this goal include propofol, etomidate, ketamine, and benzodiazepines (Mahmoud and Mason, 2018). Propofol is a common near-ideal intravenous agent with a rapid of onset after administration for anesthesia induction before using inhalational gases for maintenance. The preference for propofol to other general anesthetic drugs is due to its smooth and rapid induction without excitation phenomenon, short half-life, and favorable side effect profile such as minimal postoperative nausea and vomiting that has made it the most common agent for three decades (Sahinovic et al., 2018).Etomidate has a safer respiratory and cardiovascular risk profile but it is still given as a single bolus due to an increased risk for mortality in critically ill patients if given as a prolonged infusion (Mahmoud and Mason, 2018).Ketamine has special application in hemodynamically unstable and asthmatic patients. Ketamine has a safe hemodynamic profile and it causes bronchodilation leading to its safety in patients with asthma (Abdollahpour et al., 2020). Benzodiazepines such as diazepam and thiopental sodium also have a sedating effect which is desirable for induction of anesthesia.

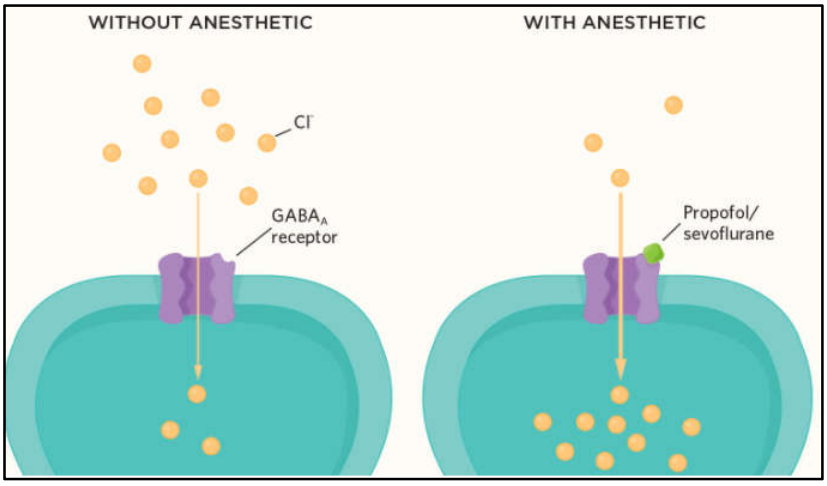

Figure 1. Mechanism of Action of General Anesthetic Medications

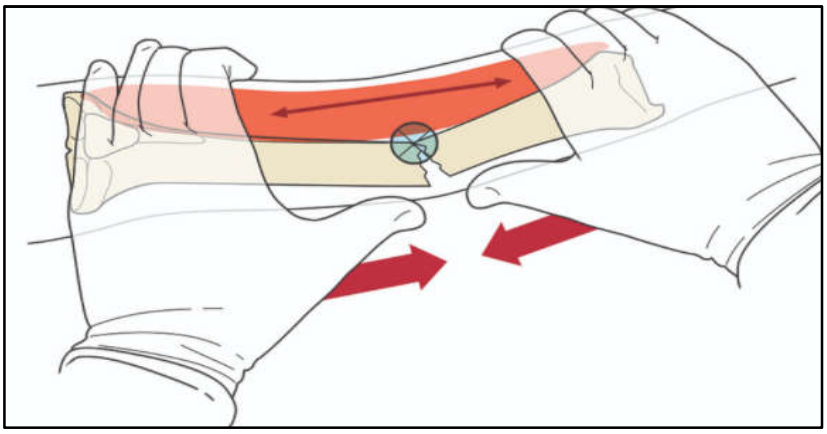

Figure 3. Fracture Reduction

Inhalational Gases: According to Smith and Goldman (2020), inhalational agents are liquids at ambient pressure and temperature which are vaporized for absorption in the lungs and they are used for anesthesia maintenance after induction. The use of halothane has been replaced with better halogenated compounds in anesthesia. Examples of the safer halogenated compounds include sevoflurane, desflurane, and isoflurane which provide smoother induction, quick anesthesia reversal, and minimal cardiovascular effects (Smith and Goldman, 2020).The inhalational agents are absorbed in the lung alveoli into the circulation where they reach and exert their pharmacodynamics effects in the brain. Elimination of the inhalational gases also takes place within the pulmonary system leading to the quicker emergence observed with the halogenated compounds. Even though inhalational gases are mainly used for maintenance of anesthesia, they can be used for induction due to difficulty in obtaining an intravenous access or in children who might fail to cooperate with the healthcare providers for intravenous induction (Sahinovic et al., 2018). Therefore, knowledge of the common and newer agents such as sevoflurane is paramount for quality anesthesiology practice.

Figure 2. Doses of Commonly Used General Anesthesia Medications

Intravenous Agents	Dose
Propofol	1mg/kg intravenous
Ketamine	10mg/kg intramuscular
Etomidate	0.4mg/kg intravenous
Thiopental	5mg/kg
Midazolam	0.1mg/kg intravenous
Inhalational Gases	Dose
Sevoflurane	4% at 2L per minute
Isoflurane	1.5% at 2L per minute
Desflurane	2% at 2L per minute
Enflurane	1.6% at 2 L per minute
Halothane	1.5% at 2L per minute

Figure 2 below shows a table with the list of the various general anesthetic agents in their various categories with the doses. The doses for intravenous agents are calculated subject to the weight of the patient while the inhalation gases are subject to the minimal alveolar concentration (MAC) of the agent. MAC isthe concentration of the gaseous compound that will prevent half of the patients from responding to a painful stimuli such as a standard surgical incision (Smith and Goldman, 2020). The inhalational gases are given as a mixture with another gas such as nitrous oxide or oxygen, and the MAC will indicate the quantity of the inhalation agent in the mix as a percentage. For example, 4% sevoflurane implies that out of the quantity of gas in the cylinder, only 4% is sevoflurane, and it is this amount of concentration which is required to achieve general anesthesia.

Advantages and Disadvantages of General Anesthesia: The advantages and disadvantages of general anesthesia are rooted on the safety of the common anesthesia medications, their pharmacokinetic properties and postoperative effects. General anesthesia medications enters the blood circulation through the pulmonary or intravenous routes, and access to the systematic circulation exerts effects that warrants knowledge of the characteristics of each agent before administration (Meng et al., 2017).

***Advantages*:** General anesthesia is easy to administer rapidly to give a rapid onset of action and a predictable duration of action which can be reversed upon completion of the operation (Oliveira et al., 2017).The inhalational gases are always present for both induction and maintenance whenever intravenous access becomes a challenge in the operation room. The use of a cap to direct flow of a gas for inhalational agents is also an easy procedure with most agents having a safe use profile. Specifically, propofol, as the typical and most commonly used intravenous agent, has the advantages of low

incidence of post-anesthesia nausea and vomiting and a smooth induction (Sahinovic et al., 2018). The anesthetic drugs also gives a predictable amount of time for the surgeon because their effect is determined by dose and reversal of an inhalational anesthetic such as the commonly used sevoflurane is through the pulmonary route (Matovinović et al., 2018). Therefore, the medication is eliminated when the patient breaths out without additional inhalation of the agent.

***Disadvantages*:** Thecons of general anesthesia are the side effects of the particular general anesthetic medications, the risk of a prolonged memory loss, and drug-specific reactions with the body (Matovinović et al., 2018).Propofol, for example causes pain at the injection site and other systemic effects such as hypotension, bradycardia, and hyperlipidemia because propofol is given as an infusion with a lipidemulsion (Sahinovic et al., 2018).Since general anesthesia causes amnesia as one of its components, there is also a risk of a prolonged memory loss among postoperative patients. General anesthesia medications can also react with the body to produce hypersensitivity reactions and malignant hyperthermia which is common especially among some patients given inhalation gases(Matovinović et al., 2018). Therefore, the use of general anesthesia should be purposive and aimed at meeting the needs of selected patients after a thorough preoperative evaluation which includes the post anesthetic history of the patient.

Indications and Contraindications for General Anesthesia: The risks of intravenous and inhalational general anesthetic medications necessitates a careful evaluation of the indications and contraindications of the medication by a certified healthcare professional. Indications are the conditions or circumstances under which general anesthesia would be recommended for a patient. On the other hand, contraindication are the circumstances under which a healthcare practitioner must avoid in entirety subjecting a patient to general anesthetic medications.

***Indications*:** General anesthesia is recommended for surgical procedures requiring deep muscle relaxation for prolonged durations, surgical procedures not achievable through local or regional anesthetics, uncooperative patients, patient preference, and operations which could compromise breathing (Smith and Goldman, 2020). For example, the components of general anesthesia such as muscle relaxation and loss of conscious would be suitable for procedures such as reduction of bone fractures to avoid the strain of contracting muscles as shown in figure 3. Certain surgical procedures for example head and neck surgeries such as dental treatments are not achievable through the loco-regional anesthesia due to the complex nature of the head and neck structures, and general anesthesia would be appropriate in this case(Lim and Borromeo, 2017). Patients especially within the pediatric age group could also be uncooperative during small operations leading to poor outcomes with local anesthesia, and this necessitates the use of general anesthesia. General anesthesia also has indications which fall outside the surgical domain. General anesthetic medications such as thiopental sodium and propofol should be initiated as a choice for third line therapy for refractory status epilepticus (Hocker, 2018; Lu, L., Xiong et al., 2019). The anesthetics medications are indicated in status epilepticus to restore the brain physio-electrical functions after undergoing a state of full anesthesia. Figure 3 above shows the significance of muscle relaxation during fracture reduction. The tensile forces within the muscle pulls the fracture segments away from each other; hence, widening the space created by the fracture. Relaxing the muscle with general anesthesia will eliminate this counter force and enable a smooth fracture reduction.

***Contraindications*:** Even though general anesthesia does not have absolute contraindications, some of the relative contraindications are poorly controlled medical conditions, a difficult airway, and significant comorbidities such as heart disease, pulmonary disease, and severe aortic stenosis (Smith and Goldman, 2020). Therefore, the attending anesthetists and surgeons must weigh the risks of anesthetizing a patient against the benefits of the surgery during the preoperative assessments.

CONCLUSION

In summary, general anesthesia is a technique required for a successful surgical management of a patient. The common intravenous anesthesia drugs are propofol, etomidate, ketamine, and benzodiazepines. Inhalational agents such as halothane, sevoflurane, and desflurane are also commonly used for induction. General anesthesia helps to ready a patient for a surgical intervention but caution should be taken to avoid exposing an at-risk patient to the dangers of the anesthesia medications.

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