

# Evaluating the Effects of Anesthetic Agents on Geriatrics to Enhance Perioperative Care Practices: A Narrative Review

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**Abstract-** Elderly patients have altered physiology in systems such as the cardiovascular, respiratory, renal, digestive, and metabolic systems, which influences the pharmacokinetics and pharmacodynamics of anesthetic drugs used during surgery. The free percentage of anesthetic drugs available is also affected by variations in plasma protein concentrations in geriatric individuals. The death rate among older individuals rises after surgery due to various comorbidities which additionally impact the effect of anaesthetic drugs. Pre- or post-operation, the clinically significant parameters such as vital sign monitoring in geriatric patients, positioning, induction and maintenance doses of the anesthetic agent, and anesthesia type must be chosen carefully to optimize the perioperative care practices and better outcomes. The purpose of this narrative review is to provide current information on the effects of anesthetic agents on older patients, as well as to optimize perioperative care practices.

**Index Terms-** Anesthetic agents, Elderly patient, Intraoperative anesthetic management, Geriatric patients, Perioperative care

## II. ALTERED PHYSIOLOGY OF GERIATRIC PATIENT

The physiology with age is altered due to oxidative damage and genetics. The changes in physiology are observed in all major body systems, which is because of the anatomy of the organs which in turn alters the physiology.

## I. INTRODUCTION

The mortality rate following surgery increases with age; the death rate in patients aged 60-69 is 2.2%, in 70-79 is 2.9%, and in patients over 85 is up to 6.2% within 30 days of surgery. The anesthetist faces issues while dealing with elderly patients over the age of 85 who are undergoing surgery and have a high mortality rate due to aging physiological processes and the progression of age-related disorders. Elderly patients are more likely to develop morbidity and mortality.

Preoperative decision-making about the use of anesthetics should be implemented with a thorough awareness of the perspective of the effects on elderly patients in the time, which can lead to an irreversible deterioration in the functioning of the body and a shortening of expectance of life after use of anesthetics and surgery [1]. This narrative review aims to provide up-to-date evidence related to the effects of anesthetic agents on elderly patients and the optimization of perioperative care practices.

### A. Cardiovascular System

The elasticity of blood vessels decreases, increasing afterload and resistance. It is also observed that Systolic blood pressure has risen in elderly patients. Hypertrophy of the left ventricle impairs diastolic filling and increases end-diastolic volume. It also reduces cardiac output and cardiac reserve while increasing the period of brain circulation. Myocardial infarction and myocardial ischemia are also common disorders among elderly persons [2,3].

### B. Respiratory system

In geriatric patients, the elasticity of the pulmonary system diminishes, as does the surface area of the lung, the compliance of the walls of the chest and lungs, vital capacity, hypoxia, hypercarbia, FEV1, FVC, Inspiratory reserve volume, and the sensitivity of reflexes in the upper respiratory tract, all of which

increase the risk of aspiration. This imparts a major threat during perioperative management [4].

### C. Hepatic system

Drug metabolism and blood supply to the liver are decreased. The reduction in medication protein binding is reported because of a reduction in plasma proteins. The liver functions will influence the selection of anesthetic drugs, as some have hepatotoxic effects [5].

### D. Central Nervous System

Grey matter, neuro-receptors, neurotransmitters, and neuron density will all be reduced, resulting in impaired sense organ activity, thermoregulation, and homeostasis. The geriatric age group is more prone to neurological dysfunctions, therefore selecting sedative medications, particularly opioids, with caution because they are more prone to postoperative cognitive dysfunction and delirium [6].

### E. Excretory System

The ability to concentrate, conserve sodium and hydrogen ions, glomeruli number, renal mass, and blood flow to the kidneys all decrease in elderly patients. In most of cases, there is an imbalance in the acid-base ratio during fluid regulation caused by a loss in ion conservation ability [7].

### F. Digestive system

The gastric emptying time, gastrointestinal motility, and mucosa surface area have all been reduced in the geriatric age group. This in turn reduces the absorption of certain oral medications and increases the risk of acid reflex diseases [5].

## III. THE EFFECTS OF ANAESTHETIC AGENTS ON DIFFERENT SYSTEMS

The effect of anesthetic agent varies from system to system especially in elderly patients due to various physiological and metabolic changes. The major effects on systems related to the administration of multimodal anesthetic agents are listed below;

### A. Cardiovascular System

The cardiac reserve is diminished in elderly persons with coronary artery disease. Such patients frequently develop myocardial infarction and ischemia during the preoperative phase when an anesthetic agent is provided. Myocardial infarctions are more likely to occur within the first three days after surgery, particularly on the first day. Frequent episodes of hypotension and autonomic dysfunction were also noted. Before the operation, a thorough history and examination, as well as the status of cardiac function, are required. Preoperatively, electrocardiogram (ECG), Echocardiography, or exercise tolerance test are advised. Both regional and general anesthetic drugs induce comparable long-term and short-term morbidity in elderly patients [8-10].

### B. Respiratory System

Postoperative pulmonary complications affect up to 10% of geriatric patients. Thoracic, abdominal, and emergency procedures have a high risk of pulmonary problems. Per

operation, a complete examination and history, including exercise tolerance testing and smoking, are required. Patients should be monitored for dyspnea, wheezing, and coughing. Epidural anesthesia can lower the incidence of lung infection and atelectasis in elderly individuals after surgery [4-8]. Following benzodiazepine and opioid administration, geriatric patients are more prone to experience breathing difficulties, respiratory depression, and apnea. Laryngeal reflex dysfunction can lead to severe pulmonary deterioration after surgery. During prolonged hypoxemia, regional and general anesthesia should be supplemented with oxygen and periodically monitored. If the hypoxemia persists for more than 6 days after surgery, oxygen treatment does not prevent episodic desaturation.

### C. Central Nervous System

Sedatives, opioids, and volatile agents are used significantly less frequently to induce anesthetic effects in elderly individuals. The preoperative analgesic is unchanged even when the pain threshold in elderly individuals increases, which is influenced by the patient's emotional and psychological state. Controlling hypertension significantly reduces morbidity and death associated with the central nervous system. The instability of hemodynamics during a surgical procedure is a significant component that can lead to central nervous system problems. Monitoring oxygen saturation, ventilation, and blood pressure, as well as identifying carotid bruits and localized neuronal symptoms, will help to prevent central nervous system morbidities.

### D. Renal System

Anesthesia and surgery have similar renal references in both young and elderly people. The most significant element to consider for surgery in older individuals is intravascular volume and the prevention of dehydration. The medications that cause nephrotoxicity and nonsteroidal anti-inflammatory medications should be avoided [10-13].

### E. Anaesthetic Use in Old Age Patients

The drug delivery mechanism of anesthetic drugs is influenced by pharmacokinetic and pharmacodynamic changes that occur with age. The quantity and number of anesthetic drugs are reduced in older individuals, limiting administration guidelines. Plasma proteins such as albumin are reduced in older people, whereas alpha acid glycoprotein increases, affecting the free fraction of anesthetic drugs. The free fraction of diazepam increases in elderly people due to its binding to albumin, whereas lidocaine binds to alpha acid glycoprotein, reducing free fraction and so affecting clearance [14-16].

Geriatric individuals undergoing surgery are frequently diagnosed with brain dysfunction, including postoperative delirium and cognitive dysfunction. The primary factor recognized as the cause of postoperative delirium is the administration of anesthetics [17-20].

Name of anesthetic agent	Pharmacokinetics and Pharmacodynamics	Geriatric Considerations
Thiopental	Decreases in the	15% decrease in induction

	volume of distribution and intercompartmental clearance. No change and no sensitivity of the brain.	dose, 2.1 mg/kg IV for 80-year-old patients and the same maintenance dose required 60 mins after the start of continuous infusion
Propofol	Decreases in the volume of distribution and intercompartmental clearance. No change and no sensitivity of the brain.	20% decrease in induction dose, 1.7 mg/kg IV for 80-year-old patient and the same maintenance dose required 120 mins after the start of continuous infusion
Midazolam	Decrease clearance Increase sensitivity	50% decrease in induction dose, 0.02-0.03mg /kg iv for 80-year-old patients 25% is the maintenance dose
Etomidate	Decreases in the volume of distribution and intercompartmental clearance. No change and no sensitivity of the brain.	20% decrease in induction dose, 0.2mg /kg IV for 80-year-old patients
Fentanyl	No change in the volume of distribution and clearance. Increase sensitivity.	Emergency can be delayed, 50% decrease in induction dose and 30-50% decrease in maintenance dose
Alfentanil	No change in the volume of distribution and clearance. Increase sensitivity.	Emergency can be delayed, 50% decrease in induction dose and 30-50% decrease in maintenance dose
Sufentanil	Decreases in the volume of distribution and intercompartmental clearance. Increase sensitivity of the brain.	Emergency can be delayed, 50% decrease in induction dose and 70% decrease in maintenance dose
Remifentanyl	Decreases in the volume of distribution and intercompartmental clearance. Increase sensitivity of brain	Emergency can be delayed, 50% decrease in induction dose and 70% decrease in maintenance dose
Mivacurium	Decrease blood flow to muscles, cardiac output plasma cholinesterase, and intercompartmental clearance.	Increases onset time and duration of action decreases maintenance dose.
Succinylcholine	Decrease blood flow to muscles, cardiac output plasma cholinesterase, intercompartmental clearance	Clinical differences are indistinguishable
Pancuronium Doxacurium Pipcuronium Vecuronium Rocuronium	Decreases in the volume of distribution and intercompartmental clearance	Increases onset time and duration of action decreases maintenance dose. Recommended dose reduced by 20%
Atracurium	No change	No change
Local Anesthetic agents	Hepatic microsomal metabolism and plasma protein binding decreases. Sensitivity of the nervous tissue is increased	The spinal and epidural anesthetic dose requirement decreases, and toxicity increases because of an increase in the free fraction of the drug

Table 1: Anesthetic agents and their relation with pharmacokinetics and pharmacodynamics in elderly patients [5]

#### IV. CLINICAL SIGNS AS A GUIDE TO CHOOSE ANAESTHETIC AGENTS IN GERIATRIC PATIENTS

##### A. Monitoring

Basic anesthetic monitoring should comprise stable hemodynamics, appropriate analgesic anesthesia throughout the surgery, oxygen saturation, temperature, circulation, and ventilation, as well as the incidence of postoperative cognitive disorders. Lowering the dose of anesthetic drugs can lessen the incidence of delirium. Invasive blood pressure monitoring is increasingly necessary for older patients [8].

##### B. Positioning

Geriatric individuals' musculoskeletal systems alter, increasing the risk of joint, nerve, and skin injury. Shifting the patient during the operation can raise the risk of infection and pain. Proper patient placement is likely to prevent stiffening of joints such as the hips, shoulders, and cervical spine. Elderly individuals typically have reduced peripheral blood circulation and frail skin, necessitating extra precautions to avoid bruising and skin tears. Pressure ulcers can be avoided by using additional padding [9].

##### C. General Anaesthesia in elderly patients

Elderly patients getting general anesthesia should first examine their airway management options. Geriatric individuals frequently have limited cervical extension, impaired laryngoscopy, and difficulty breathing through a mask. Fast-acting antihypertensives and vasopressors should be available to help keep blood pressure stable. In senior individuals, the emergence and maintenance phases of the general anesthetic can cause a delay in the recovery of respiratory function due to pharmacokinetics and pharmacodynamics [15-18].

##### D. Neuraxial Anaesthesia in Elderly Patients

Neuraxial anesthesia enhances the results of geriatric procedures. Neuraxial anesthetics are less likely to produce pulmonary problems in ill patients. The lower the sedative requirement, the lower the chance of postoperative delirium [11]. Spinal anesthesia typically causes bradycardia and hypotension in older individuals, which may be owing to the presence of heart illness [12].

#### V. DISCUSSION

Anesthesia treating older individuals is complicated since aging increases the likelihood of surgery and post-operative mortality. under elderly patients, inadequate evaluation and preparation under a pressure atmosphere contribute to morbidity and mortality following surgery. In most circumstances. In most situations, inadequacies such as insufficient oxygen delivery, imbalanced electrolytes, and blood volume are commonly detected during operational operations on older patients.

McIsaac et al. showed through the results that the multidisciplinary team's useful advice is based on the assessment before surgery, which enhances the surgery outcome and the

quality of life for the patient after surgery. The multidisciplinary team, which includes a surgeon, physician, physiotherapist, nurse, dietitian, psychiatrist, speech and language specialist, occupational therapist, palliative specialist, and pain specialist, should decide on the procedure together. The patient's consent is required, which will be sought once the patient and family have been informed of the risks and advantages of the surgery [2].

A preoperative examination should include a history of background and co-morbidities such as heart disease, arthritis, hypertension, diabetes, Parkinson's, malnutrition, and polypharmacy. Gastroesophageal reflux disease (GERD) is quite common in elderly persons and must be reported during the assessment. Medication use, including anticoagulants, and hypoglycemic drugs like insulin, diuretics, beta-blockers, ACE inhibitors, and steroids, should be disclosed alongside habits like smoking and alcohol consumption. Weight, blood pressure, oxygen saturation, fluid and electrolyte balance, nutrition, ECG, blood sugar level, blood count, and other tests should all be performed before surgery [19-21].

The intraoperative considerations include psychological preparation of the patient, intravenous access, which is problematic in older patients due to reduced dermal porosity, oxygen saturation during the treatment, and airway control. Spinal and epidural anesthesia might be challenging for people with osteoarthritis and spondylosis [22-25].

Maintenance of normal temperature throughout the procedure in elderly patients, which is due to impairment in cold sensing ability and homeostasis, as well as a reduction in the rate of metabolism, ability of vasoconstriction, and heat generation ability due to a decrease in BMI and subcutaneous fat, should be considered before selecting an anesthetic agent, which can worsen the elderly patients' condition and affect wound healing after the procedure. Postoperatively, the risk of pulmonary thromboembolism should be evaluated. Good nutrition promotes healing and rehabilitation. Monitoring blood sugar levels, as well as managing pain and fluids, are critical considerations. Rehabilitation and physical therapy aid in healing [25-28].

Since there is no anesthetic agent specifically designed for senior patients, the physiological changes in the patient as a result of age, as well as the technique that can be utilized to introduce the anesthetic agent, must be considered [29-31].

## VI. EVIDENCE ACQUISITION

Various studies linking the geriatric factors that affect the perioperative patient care practices related to anesthetic management have been reviewed following PRISMA guidelines from Medline, EMBASE, and Web of Science databases which were published between January 1, 1998, and December 31, 2023, including patients over age of sixty.

## VII. CONCLUSION

Elderly individuals undergoing surgery with anesthetic agents frequently have complications such as hypotension, bradycardia, postoperative cognitive impairment, and delirium. To avoid

morbidity and mortality, elderly patients should be followed continually before, during, and after surgery. From the review of various data, we found that the effects of anesthetic agents are determined by a variety of factors, including oxygen saturation, the nature of the anesthetic agent, such as protein binding, other diseases that may interfere with the anesthetic agent's action, physiological changes in the patients, airway management, fluid management, blood pressure management. The selection of appropriate anesthetic drugs for the geriatric population, as well as the optimization of perioperative care procedures, can improve patient outcomes and speed up recovery.

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