

Anesthesia for the elderly

Kanonidou Z, Karystianou G

3rd Dpt Anesthesiology, Hippokratio Hospital, Thessaloniki Greece

Abstract

Aging is a universal and progressive physiological phenomenon clinically characterized by degenerative changes in both the structure and the functional capacity of organs and tissues.

In general, geriatric patients are more sensitive to anesthetic agents. Less medication is usually required to achieve a desired clinical effect, and drug effect is often prolonged. The most important outcome and overall objective of perioperative care of geriatric population, is to speed recovery and avoid functional decline.

An important principle must be kept in mind when dealing with an elderly patient: Aging involves a progressive loss of functional reserve in all organ systems, to variable extend. Compensation for age-related changes is usually adequate, but limitation of physiological reserve is evident during times of stress such as the perioperative period. *Hippokratia* 2007; 11 (4): 180-182

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Corresponding author: Kanonidou Z, 3rd Dpt Anaesthesiology, Hippokratio Hospital, Thessaloniki Greece. e-mail: malliara@hol.gr

The elderly (≥ 65 yr) population is the fastest growing part of the population in many parts of the developed world. Aging increases the probability of a person to undergo surgery. Moreover, perioperative morbidity becomes more frequent in the elderly with steep increases after the age of 75.

Physiology and pathophysiology of aging

Cardiovascular

Age alters both pharmacokinetic and pharmacodynamic aspects of anesthetic management. The functional capacity of organs declines and co-existing diseases further contribute to this decline.

In terms of cardiac function, geriatric patients have decreased beta-adrenergic responsiveness and they experience an increased incidence of conduction abnormalities, bradyarrhythmias and hypertension. Fibrotic infiltration of cardiac conduction pathways make the elderly patient vulnerable to conduction delay and to atrial and ventricular ectopy. Elderly patients also have an increased reliance on Frank-Starling mechanism for cardiac output. It is therefore important to consider fluid administration carefully. In the non compliant older heart, small changes in venous return will produce large changes in ventricular preload and cardiac output. Due to diastolic dysfunction and decreased vascular compliance, the elderly patient compensates poorly for hypovolemia. Similarly, exaggerated transfusion is also poorly tolerated. (Table 1)

Respiratory

COPD, pneumonia, sleep apnea are very common among the elderly. Closing volume increases with age, and FEV1 declines 8-10% per decade due to reduced

Table 1. Cardiovascular effects of aging

Decreased arterial elasticity <ul style="list-style-type: none"> • Elevated afterload • Elevated systolic blood pressure • Left ventricular hypertrophy 	<ul style="list-style-type: none"> • Atherosclerosis • Coronary artery disease • Hypertension • Congestive heart failure • Cardiac arrhythmias • Aortic stenosis
Decreased arterial elasticity <ul style="list-style-type: none"> • Decreased heart rate • Decreased baroreceptor reflex 	

pulmonary compliance. PaO₂ decreases progressively with age because of V/Q mismatch and anatomical shunt. Thus, it is recommended that elderly patients are transferred to PACU with oxygen via nasal cannula. Postoperative respiratory complications are most common in geriatric patients. The most significant clinical predictor of adverse pulmonary outcome is the site of surgery, with thoracic and upper abdominal surgery having the highest pulmonary complication rate. (Table 2).

Table 2. Respiratory effects of aging

Decreased compliance <ul style="list-style-type: none"> • Decreased alveolar surface • Decreased residual volume • Increased closing capacity • V/Q mismatch • Decreased PaO₂ 	<ul style="list-style-type: none"> • Emphysema • Chronic bronchitis • Pneumonia • Lung cancer
Chest wall rigidity	
Decreased muscle strength <ul style="list-style-type: none"> • Decreased cough 	
Blunted response to hypercarbia and hypoxia	

Renal function

Renal blood flow and kidney mass decrease with age. Serum creatinine level remains stable due to a reduction in muscle tissue. Impairment of sodium handling, concentrating ability and diluting capacity predisposes elderly patients to dehydration and fluid overload. Reduced renal blood flow and decreased nephron mass increase the risk of acute renal failure in the postoperative period.

Nervous system

As the nervous system is the target for virtually every anesthetic drug, age related changes in nervous system function have compelling implications for anesthetic management. Aging results in a decrease in nervous tissue mass, neuronal density and concentration of neurotransmitters, as well as norepinephrine and dopamine receptors.

Dosage requirements for local and general anesthetics are reduced. Administration of a given volume of epidural anesthetic results in a more cephalic spread, having though a shorter duration of sensory and motor block. Elderly patients take more time to recover from general anesthesia especially if they were disoriented perioperatively.

Geriatric patients experience varying degrees of delirium. They are sensitive to centrally acting anticholinergic agents. The incidence of delirium is less with regional anesthesia, provided that there is no additional sedation.

Pharmacology

The circulating level of albumin which is the main plasma binding protein for acidic drugs decreases with age. On the other hand, the level of α -1 acid glycoprotein the binding protein for basic drugs increases. The effect of aging on pharmacokinetic depends upon the drug is used.

The decrease in total body water leads to a reduction in the central compartment and increased serum concentrations after a bolus administration of a drug. On the other hand, the increase in body fat results in a greater volume of distribution, thus prolonging drug action.

Drug metabolism could probably be altered by the aging effect on hepatic or renal function.

The elderly are more sensitive to anesthetic agents and generally require smaller doses for the same clinical effect, and drug action is usually prolonged. (Table 3)

• Inhalation drugs

Minimum alveolar anesthetic concentration (MAC), decreases approximately 6% for every decade. There is altered activity of neuronal ion channels associated with acetylcholine, nicotinic and GABA receptors. Alterations in ion channels, synaptic activity and receptor sensitivity is probably responsible.

• Opioids

The elderly require less doses for pain relief. Morphine clearance is decreased in the elderly. Sufentanil, alfentanil, and fentanyl are twice as potent in the elderly,

due to an increase in brain sensitivity to opioids with age. There are changes in pharmacokinetics and pharmacodynamics of remifentanyl, which is more potent in geriatric patients. Clearance and the volume of the central compartment decrease with age and the infusion rates should be titrated.

• Neuromuscular blockers

The duration of drug action may be prolonged if their metabolism depends on renal or hepatic excretion. Cisatracurium undergoes Hofmann degradation and is unaffected by age.

• Peripheral nerve blocks

The duration of analgesia may be prolonged with age depending on the baricity of the bupivacaine solution. When using 0.75% ropivacaine for nerve blocks, age is a major factor in determining the duration of motor and sensory block. When general anesthesia carries great risk for the patient, administering regional anesthesia if possible could provide an excellent solution.

Preoperative evaluation

Common diseases in the elderly have a significant impact on anesthesia and require special care.

The risk from anesthesia is more related with the presence of co-existing disease than with the age of the patient. Thus, it is more important to determine the patient's status and estimate the physiologic reserve in the preanesthetic evaluation.

If the condition can be optimized before surgery this should be done without delay, because long delays increase the rate of morbidity.

Diabetes mellitus and cardiovascular disease are very common among geriatric patients. Pulmonary complications are one of the leading causes of postoperative morbidity in elderly patients. Pulmonary optimization is needed for these patients. Laboratory and diagnostic studies, the history and physical examination are of great importance. Two more issues that must be always in mind in a geriatric patient is the significant possibility of depression, malnutrition, immobility and dehydration.

Table 3. Clinical pharmacology of anesthetic agents in the elderly

Drug	Brain sensitivity	Pharmacokinetics	Dose
Inhaled agents	↑		↓
Thiopental	↔	↓ (↓ volume)	↓
Etomidate	↔	↓ (↓ volume)	↓
Propofol	↑	↓ (↓ clearance)	↓
Midazolam	↑	↓ (↓ clearance)	↓
Morphine	↑	↓ (↓ clearance)	↓
Remifentanyl	↑	↓ (↓ clearance)	↓
Atracurium	-	-	↔
Cis- atracurium	-	-	↔

It is important to determine the cognitive status of an elderly patient. Cognitive deficits are associated with poor outcomes and higher perioperative morbidity. It is controversial whether general anesthesia accelerates the progression of senile dementia.

Elderly patients require lower doses of premedication. Opioid premedication is valuable only if the preoperative condition of the patient involves severe pain. Anticholinergics are not required since salivary gland atrophy is usually present. However, H₂ antagonists are useful, to reduce the risk of aspiration. Metoclopramide could also be used to promote gastric emptying, although the risk of extrapyramidal effects is higher in elderly patients.

Intraoperative care and anesthetic management

Advancing age is not a contradiction for either general or regional anesthesia.

Some aspects of regional anesthesia may provide benefit for the patient. It affects the coagulation system by preventing postoperative inhibition of fibrinolysis. Furthermore, it decreases the incidence of deep vein thrombosis after total hip arthroplasty.

The hemodynamic effects of regional anesthesia may be associated with reduced blood loss in pelvic and lower extremity operations. More important, the patient maintains his airway and pulmonary function.

Advanced age and general anesthesia are associated with hypothermia. Maintenance of normothermia is important as hypothermia is related to myocardial ischemia, and hypoxemia in the early postoperative period.

In case of general anesthesia it is of major importance to titrate drug doses and it would be prudent to use short-acting drugs.

The use of peripheral blocks in the elderly promises favorable outcomes without compromising the safety of the airway or risking major hemodynamic effects. However, it should always be kept in mind that there are some anatomic changes in geriatric patients and that peripheral blocks have shown to last longer in these cases.

The optimal physiological management is required to produce the best surgical outcome.

Postoperative care

Pulmonary problems are of major importance in the postoperative period.

The need for shorter hospitalization cannot be over-emphasized. Minimal-invasion surgery and regional

over general anesthesia when possible, could probably lead to a more favorable outcome for geriatric patients (Table 4).

Table 4. *Common causes of postoperative morbidity*

Atelectasis	Heart failure
Pneumonia	Delirium
Neurological disease	Acute bronchitis
Myocardial infraction	

Conclusion

Elderly patients are uniquely vulnerable and particularly sensitive to the stress of trauma, hospitalization, surgery and anesthesia in ways that are only partly understood. Accordingly, minimizing perioperative risk in geriatric patients requires thoughtful preoperative assessment of organ function and reserve, meticulous intraoperative management of coexisting disorders, and vigilant postoperative pain control.

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