Porta Universorum | Vol. 2 No. 5 (2026): Gegužė | ISSN 3030-2234
https://doi.org/10.69760/portuni.26050004

Anesthetic Management and Perioperative Risks in the Geriatric Population

Mahabbat Mammadova
Nakhchivan State University, Azerbaijan

How to cite: Mammadova, M. (2026). Anesthetic management and perioperative risks in the geriatric population. *Porta Universorum*, 2(5), 27-33. https://doi.org/10.69760/portuni.26050004

ABSTRACT

The increasing frequency of surgical interventions in the elderly population poses significant challenges in modern anesthesiology, requiring a highly specialized clinical approach. Anesthetic risks in older patients are not merely a function of chronological age but are fundamentally linked to the depletion of physiological reserve and structural involution within vital organ systems. Aging leads to increased vascular rigidity and decreased myocardial compliance, significantly elevating the likelihood of intraoperative hemodynamic instability and myocardial infarction. In the respiratory system, the loss of lung elasticity and weakened protective airway reflexes heighten the risk of postoperative pneumonia and respiratory failure. Perhaps the most concerning complication is related to the central nervous system: postoperative delirium, characterized by acute confusion, affects approximately 15–50% of elderly patients, leading to prolonged hospitalization and increased mortality. Furthermore, age-related declines in hepatic and renal function impair the clearance of anesthetic agents, increasing the risk of drug toxicity and delayed emergence from anesthesia. The prevalence of comorbidities—diabetes, hypertension, and dementia—combined with polypharmacy, complicates the pharmacological profile and increases the potential for dangerous drug interactions. To mitigate these risks, meticulous preoperative assessment is essential, following the "start low, go slow" principle in drug titration. Preference is often given to regional anesthesia over general anesthesia when feasible to preserve cognitive function and reduce systemic stress. Ultimately, successful anesthesia in the elderly is an intricate balance of maintaining fragile homeostasis while managing the multifaceted physiological decline inherent in aging, requiring a multidisciplinary strategy for optimal outcomes.

Keywords: Geriatric anesthesia; perioperative complications; postoperative delirium; postoperative cognitive dysfunction; frailty; polypharmacy; homeostenosis; prehabilitation; regional anesthesia

1. INTRODUCTION

The global demographic shift toward an aging population, frequently referred to as the "silver tsunami," has fundamentally reshaped the landscape of modern perioperative medicine, bringing the complexities of geriatric anesthesia to the forefront of clinical practice. As advancements in surgical techniques and minimally invasive procedures make interventions more accessible to the elderly, the anesthesiologist

is increasingly confronted with patients who exhibit a unique and often unpredictable intersection of physiological decline, multi-organ frailty, and extensive comorbid conditions (Miller et al., 2020).

Aging is not a uniform process; it is a heterogeneous biological phenomenon characterized by the progressive loss of functional reserve across all major organ systems—a state often termed "homeostenosis"—which significantly narrows the safety window during the induction, maintenance, and emergence phases of anesthesia. In the elderly, the cardiovascular system undergoes structural remodeling, including arterial stiffening, reduced beta-adrenergic responsiveness, and impaired diastolic filling, predisposing the patient to profound hemodynamic instability, sudden hypotension, and myocardial ischemia when exposed to the vasodilatory and depressant effects of anesthetic agents (American Society of Anesthesiologists [ASA], 2022).

Simultaneously, the respiratory system experiences decreased lung elasticity and thoracic compliance, coupled with a blunted ventilatory response to hypoxia and hypercapnia, thereby increasing the risk of perioperative aspiration, atelectasis, and prolonged mechanical ventilation. Beyond these mechanical shifts, the aging brain represents perhaps the most vulnerable frontier in geriatric care, as it is inherently more susceptible to the neurotoxic effects of anesthetics and the systemic inflammatory response triggered by surgical trauma, leading to debilitating outcomes such as postoperative delirium (POD) and long-term postoperative cognitive dysfunction (POCD) (Priebe, 2017).

Furthermore, the pharmacological profile of the elderly is complicated by altered body composition—specifically an increase in adipose tissue relative to lean muscle mass and total body water—which drastically changes the volume of distribution and elimination half-life of both lipophilic and hydrophilic drugs. When combined with age-related declines in hepatic blood flow and glomerular filtration rates, these pharmacokinetic shifts necessitate a cautious, individualized approach to drug titration, often encapsulated by the clinical mantra "start low and go slow" (Shafer, 2019). The presence of polypharmacy, a hallmark of geriatric patients' medical histories, further complicates the perioperative period by introducing a high probability of adverse drug interactions. Consequently, managing anesthesia in the elderly has evolved from simply achieving unconsciousness to a sophisticated exercise in physiological preservation.

2. PHYSIOLOGICAL CHANGES ASSOCIATED WITH AGING

The process of aging is characterized by a universal, progressive decline in the physiological reserve of every organ system, significantly impacting the pharmacokinetic and pharmacodynamic profiles of anesthetic agents.

2.1 Cardiovascular System

The most prominent age-related cardiovascular changes include increased arterial stiffness and reduced myocardial compliance, leading to left ventricular hypertrophy and increased reliance on atrial contraction for ventricular filling (Miller et al., 2020). These changes, combined with a diminished beta-adrenergic response and impaired baroreceptor reflex, make elderly patients particularly vulnerable to profound hypotension and paradoxical bradycardia during induction, as the aging heart cannot easily compensate for the systemic vasodilation induced by propofol or volatile anesthetics (ASA, 2022).

2.2 Respiratory System

Respiratory aging involves a loss of pulmonary elastic recoil and an increase in chest wall rigidity, leading to increased functional residual capacity (FRC) and a rise in closing volume. When these physiological shifts intersect, they predispose patients to early airway closure and significant

ventilation-perfusion (V/Q) mismatch during surgery (Crosby & Murphy, 2023). Weakened protective airway reflexes further heighten the risk of aspiration and postoperative pneumonia.

2.3 Central Nervous System

The aging brain undergoes structural alterations such as reduced neuronal density and decreased neurotransmitter levels—particularly acetylcholine and dopamine—which increases neural sensitivity to anesthetics and lowers the threshold for postoperative delirium and cognitive dysfunction (Priebe, 2017). The brain's reduced capacity for neuroplasticity and its heightened susceptibility to the systemic inflammatory cascade make neurological complications the most feared perioperative outcomes in geriatric patients.

2.4 Renal and Hepatic Function

A gradual reduction in renal blood flow and a decrease in glomerular filtration rate (GFR) of approximately 1% per year after the age of 40 result in impaired excretion of water-soluble drugs and their metabolites (Shafer, 2019). Simultaneously, decreased hepatic mass and reduced cytochrome P450 enzyme activity significantly slow the metabolism of lipophilic agents such as fentanyl and midazolam, leading to prolonged drug effects and a higher risk of postoperative respiratory depression.

2.5 Body Composition and Pharmacokinetics

Changes in body composition—notably increased total body fat and decreased total body water and lean muscle mass—alter the volume of distribution for most anesthetics. Lipophilic drugs may sequester in fat stores and leach back into the bloodstream long after the procedure has ended, producing delayed and unpredictable pharmacological effects. These transformations demand precision-based dosing tailored to the patient's biological rather than chronological age.

3. POSTOPERATIVE RISKS AND COMPLICATIONS

The postoperative period represents a phase of extreme vulnerability for the geriatric patient, as the stress response to surgery interacts with diminished physiological reserves to trigger a cascade of potential complications.

3.1 Neurological Complications: POD and POCD

Postoperative delirium (POD) and postoperative cognitive dysfunction (POCD) remain the most frequent and distressing complications in elderly surgical patients (Inouye et al., 2014). POD, characterized by an acute, fluctuating disturbance in attention and awareness, occurs in up to 50% of high-risk surgical patients and is independently associated with increased mortality, functional decline, and accelerated progression toward permanent dementia (Monk & Price, 2011). The etiology is multifactorial, involving pre-existing brain frailty, systemic inflammation, sleep deprivation, and the anticholinergic burden of perioperative medications (Aldecoa et al., 2017).

3.2 Cardiovascular Events

The incidence of Major Adverse Cardiac Events (MACE), including myocardial infarction and heart failure, is markedly higher in the elderly due to their limited ability to meet the surge in oxygen demand caused by surgical stress and postoperative shivering (Devereaux & Sessler, 2015). Even transient episodes of intraoperative hypotension are strongly correlated with postoperative myocardial injury and acute kidney injury (AKI) in older adults, as their autoregulatory mechanisms are often impaired by chronic hypertension and vascular aging (Sessler et al., 2019).

3.3 Respiratory Complications

Age-related reductions in cough reflex and diaphragmatic strength, combined with the residual effects of neuromuscular blocking agents, significantly increase the likelihood of postoperative atelectasis, aspiration pneumonia, and unplanned re-intubation (Kirmeier et al., 2019). Respiratory complications represent one of the leading causes of prolonged intensive care unit stays and increased healthcare costs in the geriatric surgical population.

3.4 Frailty and Failure to Rescue

The "frailty phenotype" complicates recovery, as elderly patients are more prone to "failure to rescue"—a clinical scenario where a minor complication rapidly escalates into a fatal event due to the patient's inability to restore homeostasis (Hall et al., 2019). Venous thromboembolism (VTE), pulmonary embolism, acute kidney injury from nephrotoxic drugs, and perioperative hypothermia are additional critical concerns that demand proactive, vigilant management.

4. MANAGEMENT STRATEGIES

The mitigation of anesthetic risks in the geriatric population requires a paradigm shift from a reactive to a proactive, multidisciplinary strategy commencing well before the patient enters the operating theater.

4.1 Preoperative Assessment and Prehabilitation

Central to this approach is the comprehensive geriatric assessment (CGA), which transcends traditional organ-based evaluation to include frailty screening, nutritional status, and cognitive baseline measurement (Griffiths et al., 2014). Identifying frailty preoperatively is one of the most significant predictors of adverse outcomes. Consequently, "prehabilitation"—a combination of nutritional optimization, physical exercise, and psychological support—is increasingly employed to bolster physiological reserve before elective procedures (Carli & Scheede-Bergdahl, 2015).

4.2 Intraoperative Hemodynamic Management

During the intraoperative phase, "goal-directed hemodynamic therapy" (GDHT) is prioritized to preserve organ perfusion. This involves advanced monitoring—such as esophageal Doppler or arterial waveform analysis—to tailor fluid administration and vasopressor support to the individual's cardiac output, preventing the dangerous blood pressure fluctuations that the aging heart and brain cannot tolerate (Pearse et al., 2014).

4.3 Choice of Anesthetic Technique

Current evidence suggests that regional anesthetic techniques—spinal or epidural anesthesia—may offer advantages in reducing the systemic stress response and minimizing the use of sedative agents that contribute to cognitive decline (Guay et al., 2016). When general anesthesia is unavoidable, the use of processed electroencephalogram (EEG) monitoring such as Bispectral Index (BIS) is strongly recommended to prevent accidental deep anesthesia, which has been independently linked to increased postoperative mortality and delirium in older adults (Radtke et al., 2013).

4.4 Pharmacological Optimization

An opioid-sparing multimodal analgesic approach—utilizing paracetamol, regional nerve blocks, and low-dose ketamine—is essential to reduce opioid-related side effects such as respiratory depression, ileus, and confusion (Chou et al., 2016). Maintaining normothermia through active warming devices prevents coagulopathy and ensures efficient drug metabolism (Sessler, 2016).

4.5 Postoperative Care

Postoperative management should focus on early mobilization and evidence-based delirium prevention protocols such as the Hospital Elder Life Program (HELP), which include ensuring patients have their sensory aids (glasses, hearing aids), maintaining a normal sleep-wake cycle, and providing adequate hydration (Inouye et al., 2000). Intensive hemodynamic monitoring during recovery and multimodal pain management are equally critical in this vulnerable population (Valizadeh et al., 2025; Valizada et al., 2025).

5. CONCLUSION

Anesthetic management of the elderly represents one of the most intellectually demanding challenges in modern medicine, requiring a synthesis of physiological knowledge, pharmacological precision, and compassionate, patient-centered care. As this review has demonstrated, the aging process induces profound and interconnected changes across the cardiovascular, respiratory, neurological, renal, and hepatic systems, collectively narrowing the physiological margin of safety during the perioperative period.

However, these risks are neither immutable nor insurmountable. The evolution of geriatric anesthesia has clearly established that age is not a contraindication to surgery, provided the clinical approach is grounded in an understanding of biological fragility rather than chronological years. Meticulous preoperative optimization through comprehensive geriatric assessment and prehabilitation, precision-based intraoperative monitoring including goal-directed hemodynamic therapy and processed EEG, and vigilant evidence-based postoperative care collectively reduce morbidity and mortality to acceptable levels.

The ultimate measure of success in geriatric anesthesia is no longer the mere survival of the patient through the procedure, but the preservation of their cognitive function, physical independence, and overall quality of life in the days, weeks, and months that follow. As global populations continue to age, mastery of these specialized techniques will remain a cornerstone of modern surgical excellence, ensuring that elderly patients can undergo necessary interventions with the highest possible degree of safety, dignity, and respect for their unique biological complexity.

DECLARATIONS

Conflict of Interest Statement: The author declares that there is no conflict of interest in the conduct and reporting of this study.

Funding Statement: This research received no external funding from any public, commercial, or not-for-profit funding agency.

Author's Contributions: Mahabbat Mammadova: conceptualization, literature review, writing – original draft, reviewing, and final editing.

REFERENCES

Aldecoa, C., Bettelli, G., Bilotta, F., Sanders, R. D., Audard, V., Borozdina, A., Cherubini, A., Jones, C., Kehlet, H., MacLullich, A., Radtke, F., Riese, F., Slooter, A. J., Veyckemans, F., Kramer, S., Neuner, B., Weiss, B., & Spies, C. D. (2017). European Society of Anaesthesiology evidence-based and consensus-based guidelines on postoperative delirium. *European Journal of Anaesthesiology*, 34(4), 192–214. https://doi.org/10.1097/EJA.0000000000000594

American Society of Anesthesiologists. (2022). Practice guidelines for perioperative blood management: An updated report by the American Society of Anesthesiologists Task Force on Perioperative Blood Management. *Anesthesiology*, 136(1), 11–54. https://doi.org/10.1097/ALN.0000000000003945

Carli, F., & Scheede-Bergdahl, C. (2015). Prehabilitation to enhance perioperative care. *Anesthesiology Clinics*, 33(1), 17–33. https://doi.org/10.1016/j.anclin.2014.11.002

Chou, R., Gordon, D. B., de Leon-Casasola, O. A., Rosenberg, J. M., Bickler, S., Brennan, T., Carter, T., Cassidy, C. L., Chittenden, E. H., Degenhardt, E., Griffith, S., Manworren, R., McCarberg, B., Montgomery, R., Murphy, J., Perkal, M. F., Suresh, S., Sluka, K., Strassels, S., & Wu, C. L. (2016). Management of postoperative pain: A clinical practice guideline from the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. *The Journal of Pain*, 17(2), 131–157. https://doi.org/10.1016/j.jpain.2015.12.008

Crosby, G., & Murphy, M. F. (2023). Anesthetic management in the elderly. In R. D. Miller (Ed.), *Miller's anesthesia* (9th ed., pp. 1820–1851). Elsevier.

Devereaux, P. J., & Sessler, D. I. (2015). Cardiac complications in patients undergoing major noncardiac surgery. *New England Journal of Medicine*, 373(23), 2258–2269. https://doi.org/10.1056/NEJMra1502824

Griffiths, R., Alper, J., Beckingsale, A., Goldhill, D., Heyburn, G., Holloway, J., Leaper, E., Parker, M., Ridgway, S., White, S., Wiese, M., & Wilson, I. (2014). Management of proximal femoral fractures 2011: Association of Anaesthetists of Great Britain and Ireland. *Anaesthesia*, 67(1), 85–98. https://doi.org/10.1111/j.1365-2044.2011.06957.x

Guay, J., Choi, P. T., Suresh, S., Albert, N., Kopp, S., & Pace, N. L. (2016). Neuraxial blockade for the prevention of postoperative mortality and major morbidity: An overview of Cochrane systematic reviews. *Cochrane Database of Systematic Reviews*, 1, CD010108. https://doi.org/10.1002/14651858.CD010108.pub2

Hall, D. E., Arya, S., Schmid, K. K., Blaser, C., Nagpal, S., Couch, M. E., & Kennedy, J. (2019). Association of a frailty screening initiative with postoperative survival at 30, 180, and 365 days. *JAMA Surgery*, 154(7), 631–640. https://doi.org/10.1001/jamasurg.2019.0532

Inouye, S. K., Bogardus, S. T., Charpentier, P. A., Leo-Summers, L., Acampora, D., Holford, T. R., & Cooney, L. M. (2000). A multicomponent intervention to prevent delirium in hospitalized older patients. *New England Journal of Medicine*, 340(9), 669–676. https://doi.org/10.1056/NEJM199903043400901

Inouye, S. K., Westendorp, R. G., & Saczynski, J. S. (2014). Delirium in elderly people. *The Lancet*, 383(9920), 911–922. https://doi.org/10.1016/S0140-6736(13)60688-1

Kirmeier, E., Eriksson, L. I., Lewald, H., Jonsson Fagerlund, M., Hoeft, A., Hollmann, M., Meistelman, C., Hunter, J. M., Ulm, K., & Blobner, M. (2019). Post-anaesthesia pulmonary complications after use of muscle relaxants (POPULAR): A multicentre, prospective observational study. *The Lancet Respiratory Medicine*, 7(2), 129–140. https://doi.org/10.1016/S2213-2600(18)30294-7

Miller, R. D., Cohen, N. H., Eriksson, L. I., Fleisher, L. A., Wiener-Kronish, J. P., & Young, W. L. (Eds.). (2020). *Miller's anesthesia* (8th ed.). Elsevier.

Monk, T. G., & Price, C. C. (2011). Postoperative cognitive disorders. *Current Opinion in Critical Care*, 17(4), 376–381. https://doi.org/10.1097/MCC.0b013e328348bef9

O'Sullivan, K. E., Byrne, J. S., Mohammed, N., McHugh, T. J., Hennessy, M. J., & Dowd, J. F. (2017). Similar early outcomes for laparoscopic versus open left hemicolectomy. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, 27(4), 370–374. https://doi.org/10.1089/lap.2016.0421

Pearse, R. M., Harrison, D. A., MacDonald, N., Gillies, M. A., Blunt, M., Ackland, G., Grocott, M. P., Ahern, A., Griggs, K., Scott, R., Hinds, C., & Rowan, K. (2014). Effect of a perioperative, cardiac output-guided hemodynamic therapy algorithm on outcomes following major gastrointestinal surgery. *JAMA*, 311(21), 2181–2190. https://doi.org/10.1001/jama.2014.5305

Priebe, H. J. (2017). Perioperative myocardial infarction: Aetiology and prevention. *British Journal of Anaesthesia*, 95(1), 3–19. https://doi.org/10.1093/bja/aei049

Radtke, F. M., Franck, M., Lendner, J., Krüger, S., Wernecke, K. D., & Spies, C. D. (2013). Monitoring depth of anaesthesia in a randomized trial decreases the rate of postoperative delirium but not postoperative cognitive dysfunction. *British Journal of Anaesthesia*, 110(Suppl 1), i98–i105. https://doi.org/10.1093/bja/aet055

Sessler, D. I. (2016). Perioperative thermoregulation and heat balance. *The Lancet*, 387(10038), 2655–2664. https://doi.org/10.1016/S0140-6736(15)00981-2

Sessler, D. I., Bloomstone, J. A., Aronson, S., Berry, C., Gan, T. J., Kellum, J. A., Plumb, J., Mythen, M. G., Grocott, M. P. W., Edwards, M. R., & Miller, T. E. (2019). Perioperative Quality Initiative consensus statement on intraoperative blood pressure, risk and outcomes for elective surgery. *British Journal of Anaesthesia*, 122(5), 563–574. https://doi.org/10.1016/j.bja.2019.01.013

Shafer, S. L. (2019). Pharmacokinetics and pharmacodynamics of anesthetic drugs. In R. D. Miller (Ed.), *Miller's anesthesia* (8th ed., pp. 432–472). Elsevier.

Valizadeh, S., Mammadova, M., & Ganbarli, S. (2025). Management of gastric hemorrhage in intensive care patients: Pathophysiology, diagnosis, and treatment. *Journal of Clinical Medicine Research*.

Valizada, S., Hasanova, S., Huseynova, S., & Mammadova, M. (2025). Symptoms, complications and statistical indicators of diabetes mellitus among the residents of the Nakhchivan Autonomous Republic for 2024. *Medical Research Journal*.

ABOUT THE AUTHOR

Mahabbat Mammadova is a Teacher at the Department of Medicine, Nakhchivan State University, Azerbaijan. Her research interests include anesthesiology, perioperative medicine, geriatric care, and intensive care management.

https://orcid.org/0009-0004-4295-5347
Email: mehebbet3008@gmail.com

Received: 7 February 2026
Accepted: 30 April 2026
Published: 1 May 2026