

REVIEW PAPER

Geriatric Anaesthesia: A review

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ABSTRACT

Aging is a gradual and progressive decline in body function as a result of degenerative changes in both the structure and the function of organ system. Anaesthetic agents have variable effect on geriatric patients requiring less dose and having prolong effect. Fast recovery without any functional decline are the most important objective of anaesthetic management of geriatric population. As aging involves a decrease in functional reserve in all organ systems in variable capacity, proper peri-operative care in must taking into account for the same in order to avoid complication.

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Introduction

Geriatric population is defined as having age of 65 years or older. According to the US Department of Health and Human Services, people aged 65 and older represented 15% of the population in 2014, but that is expected to increase, with some estimates predicting the elderly will comprise 22% of the population by 2040.^[1] Forty to Fifty percent will eventually require surgery and in geriatric population its seen that perioperative death increases to threefold risk. Important to understand normal changes in physiology, anatomy, and response to pharmacologic agents careful preoperative evaluation is necessary.

The elderly (≥ 65 yr) population is the fastest growing part of the population in many parts of the developed world with steep increase in perioperative morbidity after the age of 75. Aging is an universal and progressive physiological phenomenon clinically characterized by degenerative changes in both the structure and the functional capacity

of organs and tissues. Aging increases the probability of a person in a lifetime to undergo surgery.

Physiology and pathophysiology of aging

Age alters both pharmacokinetic and pharmacodynamic aspects of anaesthetic management. The functional capacity of organs decline and co-existing diseases further contribute to this decline. (Fig. 1)

Cardiovascular system

Geriatric patient has cardiovascular compromise because of several factors. They have diminished beta-adrenergic responsiveness, increased incidence of hypertension and various forms of conduction abnormalities. This could be attributed to replacement of normal conduction pathway by fibrotic tissue. Geriatric patients have increase dependency on Frank-Starling mechanism for maintaining cardiac output.

It is important to consider fluid administration carefully. Due to non compliant ageing heart (diastolic dysfunction) and decreased vascular compliance small changes in venous return will cause changes in ventricular preload and cardiac output. Further, elderly patient compensates poorly for hypovolemia and excess transfusion.^[2,3]

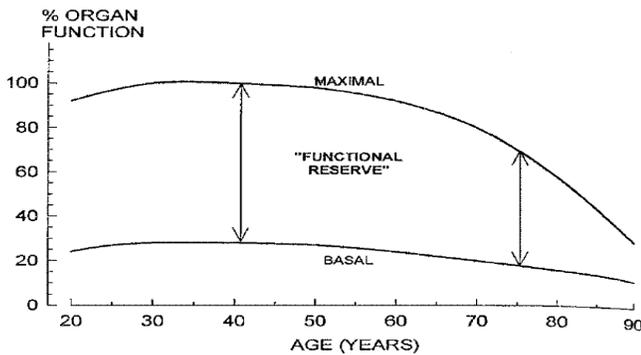


Fig. 1: Organ Functional Reserve: Safety Margin of Organ Capacity

Respiratory system

Elderly are commonly associated with respiratory problems like Sleep apnea, COPD, pneumonia, etc. There is decline OF 8-10% per decade in FEV1 due to diminished pulmonary compliance. Also, the closing volume increases as age increases and so as PaO₂ due to ventilation/perfusion mismatch and anatomical shunt. Typical barrel chest appearance results in increased work of breathing and reduced compliance.

Loss of elastic recoil within the lung and changes in surfactant production leads to limited maximal expiratory flow. Lung volumes shows increase in Residual volume (RV), closing capacity, Functional residual capacity (FRC), minimal decrease in Total lung capacity (TLC), decrease in vital capacity (VC), progressive decrease in FEV1 / FVC. The decrease efficiency in alveolar gas exchange resulting in decreased PaO₂ and increase alveolar-arterial gradient and impaired response to hypoxia, hypercarbia and mechanical stress.^[4] Thus, it is recommended that elderly patients are transferred to PACU with oxygen. 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.

Renal system

With ageing the renal blood flow and nephron mass also decrease with increased risk of acute renal failure in the postoperative period. By 80 years around half of the glomeruli in young adults may be non-functional. Serum creatinine remains stable due to a reduction in muscle mass. Impairment of sodium handling, concentrating ability and diluting capacity predisposes elderly pts to dehydration and fluid overload. Glomerular filtration rate declines by 6-8% per decade (parallels reduction in cardiac output).^[5,6]

Nervous system

Ageing results in decreased nervous tissue mass, neuronal density, concentration of neurotransmitters, norepinephrine and dopamine receptors. There is decline in neural density and loss of brain mass by 30% by age of 80 years (mostly grey matter). Also the neuronal transmitters are reduced. However, in absence of disease neuronal activity, blood flow metabolism, auto-regulation and cerebrovascular response to CO₂ remain intact. Because of this dosage requirements for local and general anaesthetics are reduced. For a given volume of epidural anaesthetic results in more cephalic spread, with a shorter duration of sensory and motor blockade. Recovery from General anaesthesia (GA) takes more time in elderly especially if they were disoriented preoperatively, experience varying degrees of delirium, and sensitive to centrally acting anticholinergic agents. Provided there is no added sedation, regional anaesthesia (RA) causes less delirium.^[7,8]

Pharmacology

Because of decreased renal and hepatic function, decreased protein binding and altered volume of distribution by ageing drug metabolism could probably be altered with age, circulating level of albumin decreases which act as binding protein for acidic drugs. While there is increase in the level of α -1 acid glycoprotein which act as binding protein for basic drugs. The total water redistribution leads to a reduction in the central compartment and increased serum concentrations after a bolus administration of a drug. However, there is increase in body fat which results in a greater volume of distribution, thus prolonging drug action. Thus, the elderly generally require smaller doses for the same clinical effect, and drug action is usually prolonged so care must be taken in deciding doses.^[9]

Inhalation drugs

There is decrease of around 6% in minimum alveolar anaesthetic conc. (MAC) for every decade.^[9] Typically 66-75% anaesthetic concentration is required by an 80 year old as compared to a young adult.^[10] Altered activity of neuronal ion channels, synaptic activity and receptor sensitivity can be probable cause.

Opioids

Less doses is requires for pain in elderly. Morphine clearance is decreased. Increased brain sensitivity sufentanil, alfentanil, and fentanyl makes them twice as potent in the elderly. . Remifentanyl is also potent in geriatric patients. However, for all cases infusion rates should be titrated because of decreased volume of distribution and protein binding.

Neuromuscular blockers

Neuromuscular blockade density increases with increasing age, hypothermia and increased duration of surgery. Short or intermediate acting neuromuscular blocking agents (NMBA) should be used to in all elderly patients in whom extubation is planned. Atracurium and cis-atracurium undergoes Hoffmann elimination, and elimination is renal dependent so action is not prolonged.^[11]

Peripheral nerve blocks

Regional anaesthesia provides an excellent alternative if GA is having risk. With age there might be prolong analgesia duration on the basis of baricity of bupivacaine solution. Age is also major limiting factor in calculating duration of sensorymotor blockade when 0.75% ropivacaine is used for nerve blocks.

Preoperative evaluation

Pre-operative visit is very important as its provide an opportunity to check medications and remove unwanted drugs. Further, it helps in evaluating patient's condition and physiologic reserve. Decreasing the co-morbidities have shown better results than just patient age. So, early diagnosing and optimising the co-ailments can decrease mortality and morbidity associated with anaesthesia.

Among the various co-morbidities diabetes mellitus (DM) and cardiovascular diseases (CVD) are very common. Optimising insulin requirement and identifying complications of DM is

very essential. Similarly CVD should be properly tested or else it could lead to devastating results.^[12] Apart from this other leading cause morbidity in post operative period is pulmonary complications. Smoking, low serum albumin levels, prior respiratory disease, presence of obstructive pulmonary disease and old age increase the frequency of pulmonary complications.^[6,13] So, proper history, examination and investigations should be undertaken for better results. Also, depression, malnutrition, immobility and dehydration have to be taken care in geriatric population. So, proper cognitive evaluation is essential part of examination in elderly. Cognitive deficits lead to with poor outcomes and higher perioperative morbidity.^[6,8] Elderly patients require lower doses of premedication drugs. Opioid premedication is valuable only if there is severe preoperative pain. Since in elderly salivary glands are atrophied anticholinergics are not required. For gastric emptying Metoclopramide is used and chances of aspiration can be minimised with H₂ antagonists.

Intraoperative care and anaesthetic management

Age is not limiting factor in choosing RA or GA. RA may beneficial in various ways as it has reduced postoperative negative nitrogen balance, less surgery related stress, maintain airways and pulmonary function, decreased thrombo-embolic post operative complications, blood loss, and postoperative mental confusion. However most of it is theoretical.^[12] General anaesthesia in elderly are associated with hypothermia. Hypothermia causes increases chances of bleeding, decreased immune function and wound strength. Skeletal muscle mass loss, and decreases post-op shivering decrease the rate at which homeostasis of body temperature could be re-established in elderly.^[14] Anaesthetic agents induced inhibit the thermoregulatory responses is increased in elderly which prolong the time for clearance of anaesthetics which further increase the chance of post operative hypothermia. So in general anaesthesia, it would be wise to use short acting drugs and titrate dose accordingly. Peripheral blocks are safer but have to shown to last longer in elderly patients. So, choice of anaesthesia should be individualised.

Postoperative care

Postoperative favourable outcomes are seen with regional over general anaesthesia, shorter duration of stay in hospital, minimal-invasion surgery. Common causes of postoperative morbidity are Atelectasis, heart failure, Pneumonia, Delirium, Neurological disease, Acute

bronchitis, Myocardial infraction. Ageing leads to impaired cough reflexes, diminished immune response and decreased mucociliary clearance which increases the risk of aspiration and post operative pneumonia.^[13] Elderly patients are at an increased risk of developing hypotension and myocardial ischemia because of decreased baroreceptor sensitivity and decreased response to rennin-angiotensin system.^[6]

Postoperative delirium

Postoperative delirium is common in the elderly in the postoperative period. It can result in increased morbidity, delayed functional recovery, and prolonged hospital stay. In surgical patients, factors such as age, alcohol abuse, low baseline cognition, severe metabolic derangement, hypoxia, hypotension, postoperative pain and type of surgery appear to contribute to postoperative delirium. Anaesthetics, especially anticholinergics and benzodiazepines, increase the risk for delirium. Despite the above recommendations, postoperative delirium in the elderly is poorly understood.^[6,8,15]

Post operative Pain

Inadequately control of postoperative pain can prolong recovery and can cause cognition problem. For geriatric patients, the oral route is safe as because of low muscle mass and more fat intramuscular injections are painful, and has unpredictable absorption. NSAIDs/Opioids with short half lives can be used by parenteral route for mild to moderate pain keeping care of gastro-intestinal, hepatic and renal effects. Meperidine must be used cautiously as it rely on elimination by kidneys, it is advisable to start with one forth or half dose and then monitor closely for respiratory compromise.^[9,16]

Thus for optimum results a geriatric-anaesthesiology intervention program should include pre- and postoperative geriatric assessment, early surgery, thrombosis prophylaxis, oxygen therapy, prevention and treatment of perioperative decrease in BP, and vigorous treatment of any postoperative complication.

Conclusion

Elderly patients are different from young and have increase chances of complication as any point of anaesthesia. Apart from age associated co-morbidities increase chances of complication and should be optimised for better results.

Apart from this type of surgery, duration of stay also effect the morbidity and mortality. Last but most important are the judicious selection and use of drugs and need for individualising the therapy in elderly. Postoperative analgesia and complication should be tackled accordingly to decrease postoperative mortality and morbidity. More research in the geriatric age group will improve outcome and help us to develop expertise in geriatric anaesthesia.

References

1. Werner, C. The Older Population: 2010. Washington, DC: U.S. Census Bureau; November 2011.
2. Rooke, G.A. Cardiovascular aging and anesthetic implications. *J. Cardiothorac. Vasc. Anesth.* Aug. 2003; **17**(4): 512-523.
3. Das, S., Forrest, K. and Howell, S. General anaesthesia in elderly patients with cardiovascular disorders: choice of anaesthetic agent. *Drugs Aging.* Apr. 1 2010; **27**(4): 265-282.
4. Sprung, J., Gajic, O. and Warner, D.O. Review article: age related alterations in respiratory function - anesthetic considerations. *Can. J. Anaesth.* Dec. 2006; **53**(12): 1244-1257.
5. Barlow, I. Peri-operative renal insufficiency and failure in elderly patients. *Syllabus on Geriatric Anesthesiology ASA* 2002; pp. 1-3. 13.
6. Francis, J. Jr. Surgery in the elderly. David R. Goldman, Frank H. Brown, David M. Guarneri. Peri-operative medicine 2nd ed. USA: McGraw-Hill, Inc. 1994; pp. 385-94.
7. Thereault, J. Aging and the central nervous system. *Syllabus on Geriatric Anesthesiology ASA.* 2002; pp 1-3/ 9.
8. Crosby, G. Aging anaesthesia and brain. Implications for you and your patients. 53rd ASA Annual Meeting Refresher Course Lectures # 162. 2002; pp. 1- 7.
9. McLeskey, C.H. Pharmacokinetic and pharmacodynamic difference in the elderly. *Syllabus on Geriatric Anesthesiology ASA* 2002; pp. 1-7.
10. Muravchik, S. Pharmacological changes of aging. 53rd ASA Annual Meeting Refresher Course Lectures #19. 2002; pp 1-7.
11. Ballantyne, J.C. and Chang, Y. The impact of choice of muscle relaxant on postoperative recovery time: a retrospective study. *Anaesth Anal.*, 1997; **85**: 476-82.
12. Raymond, R. Anesthetic management of the elderly patient. 53rd ASA Annual Meeting Refresher Course Lectures #321. 2002; pp. 1-7.

13. Ross, B.K. Aging and the respiratory system. Syllabus on Geriatric Anesthesiology ASA. 2002; pp. 1-5.
14. Baraka, A.S., Taha, S.K. and Kawkabani, N. Editorial views. Pre-oxygenation. Best method for both efficacy and efficiency? *Anesthesiology* 1999; **91**: 603-5.
15. Liu, L., Leung, J.M. Peri-operative complications in elderly patients. Syllabus on Geriatric Anesthesiology. 2002; pp. 1-4.
16. Chin, M.L. Postoperative pain control in the elderly patient. Syllabus on Geriatric Anesthesiology, ASA. 2002; pp. 1-6.

