Aging: intrinsic, progressive process; genetic and lifestyle influences lead to variable rates of aging; aging can be defined on cellular level by, eg, analyzing messenger RNA and capabilities for replenishment; aging occurs in every organ; initially evident as failure of homeostatic maintenance; historical perspective—in 1800, many deaths during first 2 yr of life; in 1900s, majority of people died <60 yr of age; however, not much progress since 1960s to 1980s after development of cures for most infectious diseases and treatments of common problems (eg, cardiovascular disease); few survive beyond age 90; on average, women live longer than men.

Implications for health care: with baby boomers aging, impact seen in orthopedics, gynecology, urology, and cancer surgery; surgical treatment of cardiovascular conditions has plateaued because of development of drugs and innovations in nonoperative treatments; aging of baby boomers will significantly increase number of elderly patients requiring surgery and anesthesia; illness in geriatric patients—≥80% of individuals >65 yr of age have one chronic health problem; malnourishment (as defined by laboratory testing) occurs in 40% (primarily due to not eating healthy foods); 70% of individuals >65 yr have 2 diagnosed chronic diseases; geriatric patients account for one-third of all operations in United States, and predicted that within next 10 to 15 yr they will account for half of all operations; geriatric patients account for one-third of health care dollars, and figure will reach one-half in 10 to 15 yr; geriatric patients already consume >50% of federal health care money; baby boomers account for two-thirds of cancers and >2 million inpatient admissions/day; patients >65 yr of age likely to undergo major operation (eg, cancer surgery, cardiac procedure, repair of hip fracture, replacement of knee) during year of death; United States spends considerable amount of money on health care ($7300/person/yr), but life expectancy not as high as in many other countries.

Outcomes in geriatric patients: much more likely to suffer adverse outcomes after surgery; patient in late 90s has almost 63% risk of not surviving 30 days after major operation; patients >65 yr of age often have prolonged and difficult patterns of recovery that can last many months; mortality from simple procedures in patients in their 90s >10%; each decade increases risk for death by factor of 1.75; after high-risk cancer procedures, eg, lung resection, pancreatic resection, or exploratory laparotomy, 30-day mortality >20%.

Deterioration in health: one-half of individuals able to live independently at age 65; aging manifested as progressive deterioration of functional reserve capacity (eg, reduced ability to perform activities without shortness of breath); surgery and anesthesia cause physiologic challenge; noticeable difference in functional reserve starts occurring at ages 45 to 50; function of every organ declines; when disease first noticed, therapy may be able to restore function to near normal; treatment may also rescue patients with exacerbations and improve function; however, progressive disease or exacerbation in organ with insufficient function eventually causes death; effects of aging on organ function—every organ starts to deteriorate almost 1%/yr starting at age 20 to 30 (as measured by, eg, nerve conduction velocity, basal metabolic rate, cardiac index, glomerular filtration rate [GFR], maximum breathing capacity); other changes—decreases occur in skeletal muscle mass and total body water; intracellular water replaced by fat; increased body fat leads to changes in effects of lipid-soluble drugs and volume of distribution.

Deterioration of organ systems: skin and eyes—skin becomes thin and fragile, with increased incidence of skin cancers; gum lines recede; eyes develop cataracts, glaucoma, and macular degeneration.

Cardiovascular: changes include decreases in resting heart rate, variability in heart rate, and maximum heart rate during exercise; intrinsic rate of sinus node decreases; decreased compliance of ventricles and of vasculature; myofibril dysfunction; decreases in output of catecholamines; increased thickness of left ventricle; thickening of valves; circulation time slows, and dramatically prolonged in elderly patients; conduction system of heart begins to die, and by age 75 yr only ≤10% of cells of sinoatrial node still alive; heart becomes less recep- tive to stimulants of heart rate; young individuals respond vigorously to isoproterenol and epinephrine, but in aging patients maximal heart rates not as high; concentration of beta-receptors markedly reduced.

Pulmonary: patients in 70s and 80s have 5-fold to 6-fold increase in postoperative pulmonary complications (eg, pneumonia, hypoxemia, hypercarbia, dependence on ventilator); respiratory complications one of leading causes of death in patients >60 yr of age; decreases in total lung capacity and maximum ventilation volume; increases in ventilation/perfusion mismatch (increased dead space and shunting); when young individual given hypoxic or hypercarbic stimulus (eg,
Fio, 18% or CO2, 5% given to breathe), ventilation markedly increases, but some stimuli may not elicit any response in elderly; decreased function of respiratory musculature; vital capacity decreases; stiffening of chest wall results in increased work of breathing at rest; anaesthesiologists should avoid paralyzing and intubating elderly patients; elderly patients who breathe spontaneously almost always have better outcomes.

Brain: neurologic disorders account for 50% of incapacitation in elderly (eg, stroke); Alzheimer disease third or fourth (depending on survey) leading cause of death in United States; aging causes decreased volume, cell number, activity, protein synthesis, messenger synthesis, and metabolic rate; reduced memory and ability to learn; alteration in sleep patterns (contributes to fatigue); decreased motivation and hearing; decreased taste and smell (proposed cause of decreased appetite); major changes in release of epinephrine and norepinephrine; dysfunction of baroreceptors; hypothermia — risk dramatically increased; one study demonstrated that when individuals aged 80 left exposed in standard operating room for 1 hr, body temperature decreased average of almost 1.5°; recommended to apply warming devices (eg, Bair Hugger) in preoperative area to prepare patients for rapid cooling that occurs in operating room; hypothermia causes increased bleeding, greater need for transfusions, decreased immune function, increased vasoconstriction and blood pressure, and higher risk for myocardial ischemia; these factors may affect rates of recurrence of cancer.

Hormonal changes: elderly have decreased secretion of estrogens, testosterone, growth hormone, and cortisol; glucose tolerance test abnormal in one-third to one-half of patients at age 65; while glucose may be only slightly elevated (not high enough to treat), elderly patients do not metabolize glucose or provide energy as efficiently; diabetes present in 27% of patients >65 yr of age.

Kidney: decreased GFR; reduced ability to concentrate urine; diminished reserve of renal function; however, no statistically significant change in serum creatinine until ≥90 yr of age; majority of patients >80 yr have only one-third of normal creatinine clearance; creatinine not elevated because of decreased muscle mass.

Hematology: decreased marrow function; loss of suppressive cytokines microenvironment, which results in reduced immunocompetence and immunosurveillance (likely leading cause of increased incidence of cancer in elderly); leukopenia may occur, with susceptibility to infectious diseases; platelets remain active, which predisposes person to strokes (thrombosis on atherosclerotic plaques).

Liver: hepatic mass decreases 40% by age 80; many drugs metabolized by liver; anaesthesiologists must be aware that patients >65 yr of age have impaired metabolism of almost all drugs used in anesthesia; Food and Drug Administration (FDA) requires that all manufacturers perform specific pharmacokinetic and pharmacodynamic studies on elderly patients to determine adjustments of doses.

Other systems: reduction in size of microvilli of gut results in decreased absorption of drugs; nervous system — motor endplates flatten; concentration of acetylcholine receptors reduced; release of acetylcholine diminished.

Anesthetic considerations: half-life of drugs starts increasing at age 20 to 30; clearance of drugs starts to decline by age 50; pharmacokinetics — in elderly patients half-life of fentanyl almost 3 times higher, and midazolam 2 times higher, compared with young patients; requirements for minimum alveolar concentration (MAC) decline; changes in MAC-awake probably more important; elderly patients may not wake up with exhaled concentration of sevoflurane of 0.4; may need to reduce concentration to 0.1 for patient to awaken.

Perioperative plan: American College of Surgeons’ National Surgical Quality Improvement Program (NSQIP)/American Geriatrics Society Best Practice Guidelines (2012) gold standard for optimal preoperative and perioperative management of geriatric patients; anesthesia plan — minimize routine use of benzodiazepines; speaker administers benzo diazepine to 65-yr-old patient only upon request or for patient with extreme anxiety; usually not given for 75-yr-old patient; propofol 10 mg better choice for premedication; must wait longer to see effects of propofol; desflurane preferred over sevoflurane, and both preferred over isoflurane; avoid neuromuscular blocking agents if possible; when neuromuscular agents used, half of normal dose usually sufficient (but must wait 3 times longer to see effects); time of onset of rocuronium given at standard dose (0.6 mg/kg) in younger healthy patient ≤2 min; time of onset in elderly patients 5 min; opioids characterized by prolonged half-life and prolonged dynamic effect; forced oral fluid intake and early ambulation recommended postoperatively; NSQIP guidelines suggest ordering “nothing by mouth” (ie, clear liquids) restrictions for only 2 hr preoperatively; cardiac preload should be maximized because elderly patients with noncompliant left ventricle dependent on adequate preload; difference of 100 mL in intravascular volume may result in difference of systolic blood pressure between 90 and 120 mm Hg; other considerations — regional blocks should be considered more frequently in order to avoid use of opioids and other analgesics; every elderly patient should receive reversal agent; close monitoring in postanesthesia care unit (PACU) warranted if concerned about adequacy of reversal of muscle relaxants (reversal agents shorter acting than rocuronium).

Postoperative cognitive dysfunction (PCD): extremely common; PCD lasting 1 wk occurs in 26% of elderly patients, and in 10% may persist for 1 mo; leads to prolonged morbidity, hospital stay, and PACU stay; data show no correlation with general anesthesia vs regional anesthesia (especially if sedative hypnotics also given); best meta-analysis (Moyce et al, 2014) demonstrated that light anesthesia better than deep anesthesia; inhalation anesthetic yields similar outcomes compared with total intravenous anesthesia; inhalation anesthesia good choice for most elderly patients; anaesthesiologist should give anesthetic that he or she prefers; haloperidol (Haldol) — useful for confusion and combative ness during emergence and for known neural dysfunction and Alzheimer disease; data do not support use for routine prophylaxis, but do support use for rescue from confusion and combative ness in PACU, and preferred to administration of analgesics.

Use of propofol: to achieve target-controlled infusion level need to give 50% to 50% less for patients >65 yr of age; takes much longer to see nadir of blood pressure: peak effect of propofol in elderly only occurs at ≥10 min.

Recovery from anesthesia: use of desflurane results in significantly shorter recovery (as measured by, eg, eye opening, squeezing finger, and time to extubation) compared with sevoflurane (experienced clinicians can achieve similar effects with shorter use for rescue).
Conclusions: geriatric patients should be viewed as distinct and different in group (analogous to pediatric patients); take time during induction; minimize dosing of propofol; use combination of medications; administer “stunning” dose of propofol followed by assisted ventilation, or maintain spontaneous ventilation; utilize laryngeal-mask airway (LMA); minimize use of opioids and administer only when definitely needed; avoid overdose of muscle relaxants because reversal can be difficult; use LMA whenever possible; consider LMA for procedures in sitting position (e.g., surgery of shoulder) rather than intubation and paralysis; keep patient warm and covered; blood pressure and heart rate not predictive of cardiac function in geriatric patients; blood pressure variable; encourage patients to move and get out of bed in postoperative period; other agents — according to FDA, scopolamine patches should not be used in patients >65 yr of age; speaker agrees with this recommendation unless patient has used them before; should not be used in patients ≥75 yr because of much higher incidence of side effects; if scopolamine used, should be applied only for 6 hr; ketamine may be used in low doses with no or low-dose opioids

Suggested Reading


Acknowledgments

Dr. Leslie was recorded at the Scottsdale Anesthesia Conference, presented by Holiday Seminars and held on October 10-16, 2015, in Scottsdale, AZ. For information on upcoming CME activities from Holiday Seminars, please visit HolidaySeminars.com. The Audio Digest Foundation thanks the speakers and the sponsor for their cooperation in the production of this program.
ANESTHETIC CONSIDERATIONS IN THE GERIATRIC PATIENT

To test online, go to www.audiodigest.org and sign in to online services.
To submit a test form by mail or fax, complete Pretest section before listening and Posttest section after listening.

1. The incidence of malnourishment in the elderly is:
   (A) 5%  (B) 10%  (C) 20%  (D) 40%

2. Patients in their late 90s who undergo any major surgery have a 30-day mortality risk of:
   (A) 20%  (B) 35%  (C) 50%  (D) >60%

3. There is no statistical change in which of the following until a person is ≥90 yr of age?
   (A) Glomerular filtration rate  (C) Serum creatinine
   (B) Ability to concentrate urine  (D) Creatinine clearance

4. The half-life of midazolam is _______ times higher in elderly patients compared with young patients.
   (A) 1.5  (B) 2  (C) 3  (D) 4

5. Which of the following is a recommended agent for premedication in geriatric patients?
   (A) Benzodiazepine  (C) Propofol
   (B) Opioid  (D) Premedication not recommended

6. Which of the following is the preferred inhalation agent for elderly patients?
   (A) Desflurane  (B) Sevoflurane  (C) Isoflurane  (D) Nitrous oxide

7. The time of onset of rocuronium in elderly patients is:
   (A) 2 min  (B) 3 min  (C) 5 min  (D) 7 min

8. Which of the following approaches is most appropriate for avoiding postoperative cognitive dysfunction in the elderly patient?
   (A) Light anesthesia is preferred to deep anesthesia
   (B) Regional anesthesia is preferred to general anesthesia
   (C) Total intravenous anesthesia is preferred to inhalation anesthesia
   (D) None of the above

9. Administration of which of the following is recommended in an elderly patient who is confused and combative in the postanesthesia care unit or has known neural dysfunction?
   (A) Midazolam  (B) Fentanyl  (C) Ketorolac  (D) Haloperidol

10. In geriatric patients, the peak effect of propofol is seen after:
    (A) ≈2 min  (B) ≈4 min  (C) ≈7 min  (D) ≈10 min