Chapter

Anesthetic Consideration for Geriatric Patients

Somchai Amornyotin

Abstract

The geriatric population experiences significant alterations of numerous organ systems as a result of the aging process. They also have several co-morbidities including hypertension, cardiac disease, diabetes, cerebrovascular disease and renal dysfunction. Geriatric patients are considerably vulnerable and especially sensitive to the stress of trauma, surgery and anesthesia. A high incidence of postoperative complications in this population is observed. Appropriate perioperative care was required for geriatric patients. To date, development in anesthesia and surgical techniques has substantially reduced morbidity and mortality in the geriatric patients. Several anesthetic techniques have been utilized for these patients. However, anesthesia-related mortality in geriatric patients is quiet high. All geriatric patients undergoing surgical procedures require a preprocedural evaluation and preparation, monitoring patients during intraprocedural and postprocedural periods as well as postprocedural management. This chapter highlights the physiological changes, preprocedure assessment and preparation, anesthetic techniques, intraprocedural and postprocedural management in geriatric population.

Keywords: anesthesia, analgesia, geriatric, elderly, management

1. Introduction

The geriatric population is quickly growing and living longer, and this development is estimated to significantly increase surgical demand for both elective and emergent cases. Normally, functional reserve and organ functions are declined in the geriatric patients. Perioperative management of geriatric patients is clearly different and commonly more complex than in younger patients. The consequence of surgery and anesthesia in geriatric patients is directly related to the care they receive during the perioperative practice. However, morbidity and mortality rates after surgery in the geriatric patients are significantly higher than the younger patients. Furthermore, inhospital adverse events and prolonged duration of hospital stay are frequently observed in these patients [1, 2]. Although, age itself is not a disease process but instead serves as a chance for developing age-related diseases. The adverse events could be lessened by appropriate preoperative assessment, proper anesthetic technique and careful postoperative management.

2. Cardiovascular system

Physiologic changes of the vascular system include atherosclerosis and increased arterial wall thickness. In addition, aging leads to decrements in the extent of

autonomic control of the cardiovascular system. Aging patients have a reduced cardiac output. Systolic function could be remarkably conserved. However, cardiac responsiveness to adrenergic stimulation is declined. Maximal heart rate and cardiac output also decrease with age [3]. Consequently, baroreflex responses could not completely maintain hemodynamic stability in stressful conditions such as orthostatic hypotension and administration of vasoactive drugs. The functional capability of organs declines and co-existing diseases further contribute to this deterioration. Ischemic heart disease, hypertension, diabetes mellitus and hypercholesterolemia are common in the geriatric patients. Subsequently, autoregulation of blood flow to kidney and brain is reduced. The physiological stress response may be impaired because of decreased autonomic function. The cardiac muscle hypertrophy that develops secondary to the increased late systolic afterload leads to myocardial thickening and diastolic dysfunction. Atrial fibrillation is also common in the geriatric patients. Importantly, age changes both pharmacokinetic and pharmacodynamic aspects of anesthetic agents. Response to induction agents results in exaggerated effect on blood pressure. There is also a reduced response to atropine. Moreover, diminished responses to hypovolemia are supplementary confounded by volatile anesthetics and the sedative drugs that impair baroreflex control mechanisms [1, 3].

3. Respiratory system

Functional capacities of the respiratory system are all reduced in the geriatric patients. Decrease in chest wall compliance and the strength of respiratory muscles, making the lungs more difficult to ventilate and declining in maximum inpiratory and expiratory force. Increased alveolar compliance with collapse of small airways and subsequent alveolar hypoventilation, air trapping leading to ventilation perfusion mismatch. Additionally, collapse of small airways, consequent alveolar hypoventilation, and air trapping may lead to ventilation perfusion mismatch. The residual volume is also increased. Ventilatory response to hypoxemia and hypercapnia are deteriorated in the geriatric patients. Hypoxemia can develop easily. Moreover, the prevalence of chronic obstructive pulmonary disease intensely increases with age [4]. Atelectasis and pulmonary infections are more common in these patients. Administration of premedication could increase the patient's risk for aspiration. Combination of residual effects of anesthetic agents, prolonged effect of neuromuscular blocking drugs and postoperative pain, could significantly contribute to the respiratory complications.

4. Renal system

Aging is accompanying with a steady deterioration in renal function. Reduction of glomerular filtration rate, capability to concentrate urine, and reservation of renal function are noted. Monitoring of urine output during and after major surgery would be regularly performed. Geriatric patients do not require a specific fluid regimen. However, they are less able to achieve hypovolemia or hypervolemia. Though, postoperative renal failure is rare, reduced renal blood flow and decreased nephron mass may increase the risk [5]. Risk factors for acute postoperative renal failure include advanced age, diabetes mellitus, preexisting renal insufficiency, major vascular surgery, and recent exposure to nephrotoxins. Sympathetic stimulation, pain, surgical stress, and the use of vasoconstrictive drugs may induce subclinical renal insufficiency.

5. Nervous system

Aging results in a reduction in nervous tissue mass, neuronal density and concentration of neurotransmitters. A reduction of central nervous system function in the geriatric patients is observed. Autonomic dysfunction is related with impairment of cardiovascular reflexes, hypotension, arrhythmias and delayed gastric emptying. Temperature regulation is abnormally seen with increasing age. There is an increase in disorders of cognitive function, memory loss, and degenerative diseases such as Parkinson's disease in these patients. Dose requirements of local and anesthetic agents are reduced. Postoperative cognitive dysfunction increases with aging. Geriatric patients are sensitive to centrally acting anticholinergic drugs. Regional anesthesia or combined general and regional anesthesia could be favorable [6].

5.1 Pharmacology

The reduction of hepatic and renal functions impacts pharmacokinetic and pharmacodynamic of anesthetic drugs. This might be increased the sensitivity to these drugs. In addition, the decrease in total body water leads to a reduction in the central compartment and increased serum concentration after a bolus administration of a drug. Minimal alveolar concentration declines with age. Geriatric patients are more sensitive to anesthetic agents and normally require smaller doses for the same clinical effect. Long-acting drugs would be continued through out the hospital stay. This effect of aging on pharmacokinetic depends upon the drug is used.

5.2 Nutrition

Poor nutrition status is common in the geriatric patients. A meta-analysis presented that perioperative oral nutritional supplementation had a positive effect on serum total protein and led to fewer complications, but did not have a positive effect on postoperative mortality [7]. Prolonged preoperative fasting should be avoided in this population. The recent study has confirmed that preoperative complete geriatric assessment increases ability to predict patients at a greater risk for morbidity and mortality among the geriatric patients with advanced age or multiple comorbidities.

5.3 Musculoskeletal

All types of degenerative diseases encompass the geriatric patients. This may limit exercise tolerance and makes it difficult to assess their fitness. Epidural and spinal blocks are technically difficult. In addition, the geriatric patients are susceptible to fractures and dislocation. Positioning and pressure points should be well taken before and during the procedure.

6. Preoperative preparation

6.1 Assessment

Preoperative geriatric assessment includes functional physical status, neurocognitive function, systematic evaluation of comorbidities, substance abuse, frailty, nutrition, and medication. A complete history and clinical assessment as well as appropriate laboratory testing is required. However, preoperative evaluation of

geriatric patients characteristically is more complex than that of younger patients. Moreover, perioperative functional status could be difficult to evaluate. Aging results in the alterations in physiology that are linked to reduce the functional reserve and ability to compensate for the physiological stress.

Assessment of preoperative mental status is critical as it typically reflects on the postoperative cognitive status. Subsequently, the consumption of multiple medications so classic of the geriatric patients can change homeostatic mechanisms. All geriatric patients must have a preoperative anesthetic evaluation and preparation as well as relevant consultations. The geriatric patient is greater risk for long-term functional compromise after the stress of surgery than the younger patient. In general, geriatric patients with complex medical histories are best appreciated before the surgery to ensure that an appropriate preparation. Multidimensional assessments may help redefine standards for accomplishment of surgery [8].

6.2 Preoperative testing

Generally, routine preoperative testing of geriatric patients is not recommended unless coexisting medical sicknesses are identified or suspected. However, in the geriatric patients, our knowledge is somewhat more limited. Recent studies on routine preoperative testing in geriatric patients are observed. To date, it is not clear whether certain preoperative screening tests have a different profit in the geriatric age group. Routine screening in the geriatric patients does not significantly enhance information obtained from the patient's history. Generally, electrocardiogram is compulsory. A chest film would be decided for patients with acknowledged respiratory diseases and patients with symptomatic cardiorespiratory diseases.

According to guidelines of the American College of Cardiology and the American Heart Association for preoperative cardiac assessment, the patient's activity level is a primary element of the necessity for further evaluation [9]. Major predictors of cardiac risk are unstable coronary diseases, decompensated heart failure, significant arrhythmias and severe valvular disease. In patients with intermediate clinical predictors, the type of surgery and functional status of the patients will have major parts in defining the nature and magnitude of preoperative testing. However, no preoperative cardiovascular testing should be implemented if the results will not change perioperative management. In day case surgery, geriatric patients needed careful planning and proper preoperative assessment and preparation.

7. Anesthetic techniques

The determination of the planned anesthetic technique for surgery in geriatric patients should occur in a multidisciplinary approach. Irrespective of the type of anesthetic techniques, anesthesia should be performed by experienced anesthesiologists who are qualified to accomplish the perioperative care of geriatric patients [10]. Generally, all anesthetic techniques may be applied. The choice of anesthesia is prejudiced by numerous factors such as the patient's medical condition, type and duration of surgery, as well as skill of anesthesiologist and surgeon. To date, there is inadequate evidence to support a single best anesthetic plan for geriatric patients. In a recent review, there might be benefits to selecting regional versus general anesthesia as a primary anesthetic modality in certain patient groups. However, this issue remains controversial due to the quality of the studies and the lack of consideration of the risks of neuraxial blockade in several reports [11, 12]. No differences were detected in postoperative morbidity and mortality, rate of readmission as well as

hospitalization costs in geriatric patients undergoing regional anesthesia or general anesthesia (GA) for hip surgery [13].

8. General anesthesia

The judgment to use a general anesthesia in geriatric patients is determined by the type of surgery, and anesthesiologist and surgeon preference. Anesthesia preparation time, start time of surgery, length of surgery, time to sit, and time to walk were shorter in GA. Most general anesthetic agents depress cardiovascular and respiratory function as well as change consciousness. There are several adverse effects that happen in unpredictable, varying proportions of geriatric patients, while the cardiorespiratory adverse effects are dose-related. Oxygen desaturation and hypoxemia happens faster in the geriatric patients. Hence, appropriate preoxygenation is critical.

Alterations in pharmacokinetics and pharmacodynamics in geriatric patients affect considerably with the final action of anesthetic drugs and increase the adverse effects. Advanced age is undoubtedly related with a reduction in median effective dose requirements for all anesthetic agents. In geriatric patients, an induction dose of anesthetic agent is substantially reduced. The titration of admistered drugs is extremely recommended. Ketamine should not be used in the patient with cardiac disease or hypertension. GA might be better in geriatric patients with severe cardiorespiratory diseases. Moreover, dementia increases with age. When GA is applied, the time required for clinical recovery from neuromuscular blockade is obviously increased in geriatric patients for nondepolarizing muscle relaxants. A short or intermediate-acting muscle relaxant is planned when tracheal extubation is needed. Once paralysis is not compulsory, laryngeal mask airway could be performed in the geriatric patients with a low risk of aspiration. Careful perioperative fluid balance is required in the geriatric patients. Consequently, GA in geriatric patients is associated with hypothermia, leading to increased morbidity.

9. Regional anesthesia

Regional anesthesia (RA) may have some benefits over general anesthesia, including less thromboembolic events, confusion and respiratory problems postoperatively. Regional techniques could be utilized as a primary anesthetic modality for surgical anesthesia or could be combined with GA as an adjunctive modality to augment intraoperative and postoperative pain relief. Additionally, RA may diminish the requirement for sedative and analgesic drugs. This technique also preserves spontaneous ventilation and probable decreases postoperative complication following pelvic and orthopedic surgery [14]. However, age-related cardiovascular and sympathetic changes as well as the reduction of cardiovascular reserve may create possibly hazardous consequences. Moreover, the risk of nerve palsies, paresthesias, and other complications are increased in the geriatric population.

Peripheral blocks in the geriatric patients demonstrate satisfactory outcomes without compromising the safety of the airway or risking major hemodynamic effects. However, there are some anatomical changes including weakening of spine and intervertebral disks, fibrosis of intervertebral foramina, and reduction in fat in epidural space in these patients. Local anesthetic spread could enhance in the spinal column, and the dose of epidural medications should be decreased and given more slowly in the geriatric patients. Consequently, metabolism and clearance of

local anesthetic agents are also delayed with advanced age. The dose of local anesthetic agents would be decreased for both neuraxial and peripheral nerve blocks. Moreover, geriatric patients are more sensitive to the central effects of opioids and are at enlarged risk of apnea following neuraxial opioid administration. In addition, neuraxial anesthesia-induced hypotension usually occurs in geriatric patients. Antiplatelet medications require several days or weeks to wear off. Therefore, ticlopidine should be stopped for 14 days and clopidogrel for 7 days before neuraxial anesthesia. However, nonsteroidal anti-inflammatory drugs and aspirin could be continued.

10. Intravenous sedation

Intravenous sedation for geriatric patients is a safe and effective technique. Normally, it is utilized for mild and moderate surgical procedures especially in the rediology department and endoscopy unit [15–18]. These procedures are typically short duration and do not create severe pain. The aim of intravenous sedation for geriatric patients is to endorse the patient's safety, to minimize physical distress or pain, to provide analgesia and procedural amnesia as well as to return the patients to their baseline level of consciousness. Usually, geriatric patients are sicker with more co-morbid situations than in the younger patients. All these factors make sedation in this group a challenging task. Old age does not describe the complete indications for giving general anesthesia more habitually.

Geriatric patients have increased response to sedoanalgesic drugs with higher risks for hypoxia, respiratory depression, and apnea. Accurate assessment of the depth of anesthesia contributes to titrating drug administration to the individual patient [19]. Sedoanalgesic drugs including midazolam, fentanyl and propofol are generally used. In my sedation practice, fentanyl, midazolam and/or propofol are frequently used in a combination technique in the geriatric patients [16, 17, 20]. To date, propofol has been shown to be safe and is extensively performed for sedation and anesthesia outside the operating room. Compared to younger patients, geriatric patients may require dose reduction of midazolam and/or propofol. My previous report also confirmed that all adult patients could be discharged to the ward within 60 minutes from the end of endoscopic procedure, and the discharge time was not associated with age, American Society of Anesthesiologists physical status, and the total dose of sedative drugs [21].

11. Monitored anesthesia care

Monitored anesthesia care (MAC) is one of the most common anesthetic techniques. To date, technologic advances in the diagnostic procedures have produced an increased demand for MAC technique. Usually, MAC is suggested for geriatric patients who fear or deny general anesthesia or who are at increased risk because of age or certain concomitant medical situations. Preoperative, intraoperative and postoperative management should be performed as geriatric patients receiving general or regional anesthesia. Importantly, geriatric patients should be monitored properly by experienced personnel who are knowledgeable about pharmacokinetics and pharmacodynamics as well as qualified in airway management and resuscitation. MAC is classically selected for geriatric patients who require supervision of vital signs and administration of sedoanalgesic drugs to supplement local infiltration or regional anesthesia. Moreover, oxygen supplementation is recommended in all geriatric patients.

Medications normally used for MAC include midazolam, propofol, fentanyl, and remifentanil. However, interpatient unpredictability is noticeable with midazolam, and some geriatric patients might be delicately sensitive to its pharmacologic effects. Midazolam reduces the slope of the carbon dioxide response curve, and decreases the ventilatory response to hypoxia. Propofol retains a short context-sensitive half-life and a high plasma clearance that produce a quick awakening when utilized as the sole agent even after a sustained continuous infusion. However, propofol creates a dose-dependent effect in cardiorespiratory system [22]. To avoid undesirable effects, it is critical to decrease the initial doses in the geriatric patients. Remifentanil is an ultrashort-acting drug. Its peak effect occurs within 1-2 minutes after bolus administration [20]. Distribution and metabolism of remifentanil permit for early offset and return of spontaneous ventilation. The dose of remifentanil should be calculated to lean body mass and that geriatric patients require as much as 50%-70% dosage reduction.

12. Intraoperative care

12.1 Fluid management

Generally, fluid management should provide into account the combined effects of aging, anesthetics, analgesics, and anxiolytics on physiology. Appropriate use of intravenous fluids in geriatric patients is essential to avoid unpleasant effects of fluid administration. Insufficient hydration may often quickly deteriorate in organ functions. In high-risk geriatric patients, numerous studies have proven that goal-directed hemodynamic therapy significantly reduced postoperative morbidity and mortality [23, 24]. However, perioperative fluid monitoring is essential. The surgical patients will have been fluid depleted for at least 4-6 hours before. An anesthesiologist must be concerned of the volume status. In addition, fluid balance should be maintained during the procedure.

12.2 Pain management

A proper analgesic plan should be conducted in every geriatric patient before an operation. Many geriatric patients hurt from acute or chronic pain and increasingly apply management for their condition. Depression is common in the geriatric patients and is probable to be faced in the geriatric patient with chronic pain. Therefore, the overall proportion of chronic pain management applications increased in this population. Epidural anesthesia should be intensely considered in geriatric patients, as they offer improved function after abdominal surgery. The overwhelming majority of pain lawsuit in the claims database contained invasive procedures such as blocks and injections. An anesthesiologist should concern any unpredicted motor and/or sensory findings, and should cautiously monitor the geriatric patients for a prolonged time after the neuraxial blockade.

13. Postoperative care

13.1 Oxygen therapy

The geriatric patients are less able to increase and preserve ventilation at high levels. In addition, the responsiveness of central nervous system to hypoxia and hypercarbia is reduced. The reduction of protective reflexes, coughing and

swallowing with age can cause recurrent aspirations and pulmonary damage. The greatest incidence of myocardial ischemia is on day 2 or 3 postoperatively. Owing to the abnormalities in gas exchange characteristic of the geriatric patients, it is suggested that they should be transported to the postanesthesia care unit with 2-4 L/min of oxygen via nasal cannula, even after minor ambulatory surgery. Importantly, oxygen therapy and closed monitoring in a high dependancy unit might be required for geriatric patients.

14. Postoperative respiratory complications

The remaining effects of anesthesia could all meaningfully cause to respiratory complications [25]. Postoperative hypoxemia may happen in 20%-60% of geriatric surgical patients. As emphasized previously, geriatric patient has an increased alveolar-arterial gradient, decreased respiratory muscle strength, and diminished hypoxic and hypercarbic drives at baseline. Consequently, there is advanced loss of airway reflexes with age. Apnea and interrupted breathing after administration of narcotics are more common. Risk factors for respiratory complications include atelectasis, pneumonia, and pulmonary thromboembolism, advanced age, poor general health status, current infections, pre-existing cardiorespiratory diseases, hypoalbuminemia, and renal impairment. Supine position during recovery increases transpulmonary shunt [6]. Upper abdomen and intrathoracic procedures in geriatric patients have an independent factor in worsening postoperative hypoxemia and other respiratory complications.

Postoperative pulmonary aspiration in geriatric surgical patients is also an essential issue. Decreased respiratory muscle strength, together with reduced cough and swallowing reflexes may lessen clearance of secretions and increase the risk of pulmonary aspiration in the geriatric patients. This hazard is compounded by the effects of anesthetics, sedatives, and narcotics as well as by interventions such as tracheal intubation, nasogastric tube placement, and upper abdominal or head and neck surgery. An anesthesiologist should to be informed the geriatric patient and family members to this impending hazard and to adjust oral intake postoperatively. Geriatric patients also have a higher incidence of postoperative sleep apnea events. In some geriatric patients, intensive care management is neded.

14.1 Hypothermia

Geriatric patients are more at a higher risk of becoming hypothermic owing to anesthetic induced altered thermoregulatory mechanisms and their low basal metabolic rate. Adverse effects of postoperative hypothermia contain cardiac ischemia, arrhythmias, decreased drug metabolism, increased blood loss, wound infection, and prolonged hospital stay. In geriatric patients, every effort should be done to prevent heat losses. Numerous studies have been revealed that maintaining normothermia decreases cardiac morbidity. Several studies have been accomplished to evaluate the effects of many active or passive warming devices and methods including a forced-air warming blanket or heated humidifier circuit on perioperative hypothermia or shivering in geriatric patients [26, 27].

15. Postoperative pain

Geriatric patients are frequently undertreated for pain. Postoperative pain increases the risk of complications in the geriatric patients. However, pain

assessment in this population might be difficult due to cognitive impairment, dementia and aphasia. Insufficient postoperative analgesia may be associated with myocardial ischemia and respiratory failure [6]. However, the geriatric patient is enormously vulnerable to drug interactions and has an enhanced probability of undesirable effects. There is a correlation between postoperative pain and cognitive impairment. Postoperative pain might impair cognition and cognitive impairment could affect with the communication of postoperative pain. Multimodal drug therapy and perioperative regional analgesia could be very effective for perioperative pain management in geriatric patients. In addition, a balanced analgesic technique combining opioids, nonopioids and local anesthetic agents is also suggested.

16. Postoperative cognitive impairment

To identify postoperative cognitive impairment, clinician must be aware of the patient's habitual cognitive status to decide a reasonable assessment of alterations from their individual baseline status. Anesthesia had been concerned as a donating cause of postoperative cognitive impairment in the geriatric patients. Impairments are perceived in mood, memory, behavior, judgment, learning, language and motor function. The previous studies revealed that reduced brain functional reserve made the geriatric patients more likely to develop postoperative cognitive impairment [28]. The contributing factors might be narcotics, sedatives, anticholinergic, infection, anesthetic techniques, pain, sleep deprivation and hospitalization. Postoperative cognitive impairment could be categorized into two main groups: postoperative delirium (POD) and postoperative cognitive dysfunction (POCD). POD and or POCD affects 5-50% of geriatric patients.

Delirium is well-defined as an acute alteration in cognitive function that progresses over a brief period of time lasting for a few days to a few weeks. An incidence of POD is dependent on the type of surgery, patient's preoperative physical and cognitive status, and age of the patient. The overall prevalence of POD in geriatric patients after surgery has been appraised to be 10% [29]. The etiology of delirium is probably multifactorial and may include drug intoxication or withdrawal, drug interaction, anticholinergic agents, metabolic disturbances, hypoxia, abnormal carbon dioxide levels, sepsis, inadequate analgesia, and organic brain diseases. The incidence of POD may be less in outpatients than in hospitalized patients because of ambulatory patients return home postoperatively where suitable stimuli and support are obtainable. A previous systematic review for prevention of POD in geriatric patients scheduled for elective surgery presented that multicomponent interventions, antipsychotics, bispectral index-guidance, and dexmedetomidine treatment could successfully decrease an incidence of POD in geriatric patients undergoing elective non-cardiac surgery [30].

POCD is a syndrome well-defined by a deterioration from baseline in cognitive neuropsychological functioning which could last for months up to 1 year and possibly longer. POCD happens at rates as high as 79% at 7 days, 12.7% at 3 months in non-cardiac surgery patients [31]. The risk factors of POCD are multifactorial and may contain lower preoperative cognitive score, less educated, alcohol abuse, electrolyte abnormalities, type of surgical procedure, drug interactions, hypnotic or alcohol withdrawal, intraoperative events related to the surgical procedures as well as anesthetic agents and depth of anesthesia. Furthermore, physiological and sociological consequences of hospitalization and surgery might have a role. The only risk factor for late POCD was age. No differences between regional and general anesthesia in the incidence of postoperative cognitive impairment are noticed [32]. Interestingly, outpatients may have a superior cognitive outcome than inpatients.

17. Other considerations

Generally, postoperative nausea and vomiting (PONV) and pain are the two most common causes for unpredicted admission after scheduled outpatient surgery. Risk factors for PONV are female gender, previous PONV or motion sickness, nonsmoking status, and opioid use. In addition, geriatric patients experience an increased incidence of conduction abnormalities and bradyarrhythmias including atrial arrhythmias and atrial fibrillation. Transient, subclinical hearing loss is not uncommon after spinal anesthesia [33]. The pathophysiology is supposed to encompass movement of perilymph from the ear into the subarachnoid space as cerebrospinal fluid leaks out. The prevalence rate of mild hearing loss after spinal anesthesia differs inversely with the patient's age. Moreover, geriatric patients are at higher risk for drowsiness, confusion, urinary retention, and adverse drug interactions than the younger patiens. For geriatric outpatients, an escort should stay with the patient for at least 24 hours postoperatively.

18. Conclusion

Geriatric patients are exclusively vulnerable and particularly sensitive to the stresses of hospitalization, anesthesia and surgical procedure. However, age alone does not serve as deterrent for surgical procedures. The care of geriatric patients can be complex and will be a growing task. A balance between physiological and psychological alterations is required in these patients. No anesthetic agent or technique is clearly superior for all conditions or settings. Suitable preoperative, intraoperative and postoperative management is needed of geriatric patients. Additionally, anesthesiologists must have a knowledge of the physiological, pharmocokinetic and pharmacodynamic differences before they utilize their anesthetic techniques.

Conflict of interest

I have no conflict of interest.

Author details

Somchai Amornyotin
Department of Anesthesiology, Faculty of Medicine Siriraj Hospital,
Mahidol University, Bangkok, Thailand

*Address all correspondence to: somchai.amo@mahidol.ac.th

References

[1] Amornyotin S. Anesthesia for elderly patients. Analg Resusc Curr Res, 2017, 6 (2), 1000149.

[2] Kim KI, Park KH, Koo KH, Han HS, Kim CH. Comprehensive geriatric assessment can predict postoperative morbidity and mortality in elderly patients undergoing elective surgery. Arch Gerontol Geriatr, 2013, 56 (3), 507-512.

[3] Edelstein SB, Metry JE. Anesthesia considerations for the geriatric patient. Curr Geri Rep, 2017, 6 (3), 115-121.

[4] Incalzi RA, Scarlata S, Pennazza G, Santonico M, Pedone C. Chronic obstructive pulmonary disease in the elderly. Eur J Intern Med, 2014, 25 (4), 320-328.

[5] Novis BK, Roizen MF, Aronson S, Thisted RA. Association of preoperative risk factors with postoperative acute renal failure. Anesth Analg, 1994, 78 (1), 143-149.

[6] Lim BG, Lee IO. Anesthetic management of geriatric patients. Korean J Anesthesiol, 2020, 73 (1), 8-29.

[7] Liu M, Yang J, Yu X, Huang X, Vaidya S, Huang F et al. The role of perioperative oral nutritional supplementation in elderly patients after hip surgery. Clin Interv Aging, 2015, 10, 849-858.

[8] Schlitzkus LL, Melin AA, Johanning JM, Schenarts PJ. Perioperative management of elderly patients. Surg Clin North Am, 2015, 95 (2), 391-415.

[9] Eagle KA, Berger PB, Calkins H, Chaitman BR, Ewy GA, Fleischmann KE et al. ACC/AHA guideline update for perioperative cardiovascular evaluation for noncardiac surgery. J Am Coll Cardiol, 2002, 39 (3), 542-553.

[10] White SM, Altermatt F, Bary J, Ben-David B, Coburn M, Coluzzi F et al. International Fragility Fracture Network Delphi consensus statement on the principles of anesthesia for patients with hip fracture. Anaesthesia, 2018, 73 (7), 863-874.

[11] Guay J, Choi P, Suresh S, Albert N, Kopp S, Pace NL. Neuraxial blockade for the prevention of postoperative mortality and major morbidity: an overview of Cochrane systematic reviews. Cochrane Database Syst Rev, 2014, 1, CD010108.

[12] Nordquist D, Halaszynski TM. Perioperative multimodal anesthesia using regional techniques in the aging surgical patient. Pain Res Treat, 2014, 2014, 902174.

[13] Le-Wendling L, Bihorac A, Baslanti TO, Lucas S, Sadasivan K, Heyman J et al. Regional anesthesia as compared with general anesthesia for surgery in geriatric patients with hip fractures: does it decrease morbidity, mortality, and health care costs? Results of a single-centered study. Pain Med, 2012, 13 (7), 948-956.

[14] Urwin SC, Parker MJ, Griffiths R. General versus regional anaesthesia for hip fracture surgery: a meta-analysis of randomized trials. Br J Anesth, 2000, 84 (4), 450-455.

[15] Amornyotin S, Kachintorn U, Chalayonnawin W, Kongphlay S. Propofol-based deep sedation for endoscopic retrograde cholangiopancreatography procedure in sick elderly patients in a developing country. Ther Clin Risk Manage, 2011, 7, 251-255.

[16] Amornyotin S, Kongphlay S. Propofol-based deep sedation for percutaneous radiofrequency ablation in sick elderly patients with hepatocellular

carcinoma in a developing country. J Anesth Crit Care Open Access, 2017, 8 (3), 00303.

[17] Amornyotin S, Srikureja W, Pausawasdi N, Prakanrattana U, Kachintorn U. Intravenous sedation for gastrointestinal endoscopy in very elderly patients of Thailand. Asian Biomed, 2011, 5 (4), 485-491.

[18] Amornyotin S, Leelakusolvong S, Chalayonnawin W, Kongphlay S. Age-dependent safety analysis of propofol-based deep sedation for ERCP and EUS procedures at an Endoscopy Training Center in a developing country. Clin Exp Gastroenterol, 2012, 5, 123-128.

[19] Amornyotin S. Monitoring for depth of anesthesia: a review. J Biomed Graphics Comput, 2012, 2 (2): 119-127.

[20] Amornyotin S. Sedative and analgesic drugs for gastrointestinal endoscopic procedure. J Gastroenterol Hepatol Res, 2014, 3 (7), 1133-1144.

[21] Amornyotin S, Chalayonnavin V, Kongphlay S. Recovery pattern and home-readiness after gastrointestinal endoscopy. J Med Assoc Thai, 2007, 90 (11), 2352-2358.

[22] Amornyotin S. Sedation-related complications in gastrointestinal endoscopy. World J Gastrointest Endosc, 2013, 5 (11), 527-533.

[23] Hamilton MA, Cecconi M, Rhodes A. A systematic review and mata-analysis on the use of preemptive hemodynamic intervention to improve postoperative outcomes in moderate and high-risk surgical patients. Anesth Analg, 2011, 112 (6), 1392-1402.

[24] Gurgel ST, do Nascimento P. Maintaining tissueperfusion in high-risk surgical patients: a systemic review of randomized clinical trials. Anesth Analg, 2011, 112 (6), 1384-1391.

[25] Jin F, Chung F. Minimizing perioperative adverse events in the elderly. Br J Anesth, 2001, 87 (4), 608-624.

[26] Hong S, Yoo BH, Kim KM, Kim MC, Yon JH, Lee S. The efficacy of warming blanket on reducing intraoperative hypothermia in patients undergoing transurethral resection of bladder tumor under general anesthesia. Anesth Pain Med, 2016, 11 (4), 404-409.

[27] Seo H, Kim K, Oh EA, Moon YJ, Kim YK, Hwang JH. Effect of electrically heated humidifier on intraoperative core body temperature decrease in elderly patients: a prospective observational study. Anesth Pain Med, 2016, 11 (2), 211-216.

[28] Strom C, Rasmussen LS. Challenges in anaesthesia for elderly. Singapore Dent J, 2014, 35, 23-29.

[29] Rasmussen LS, Moller JT. Central nervous system dysfunction after anesthesia in the geriatric patient. Anesthesiol Clin North Am, 2000, 18 (1), 59-70.

[30] Janssen TL, Alberts AR, Hooft L, Mattace-Raso F, Mosk CA, van der Laan L. Prevention of postoperative delirium in elderly patients planned for elective surgery: systematic review and meta-analysis. Clin Interv Aging, 2019, 14, 1095-1117.

[31] Berger M, Nadler JW, Browndyke J, Terrando N, Ponnusamy V, Cohen HJ et al. Postoperative cognitive dysfunction: minding the gaps in our knowledge of a common postoperative complication in the elderly. Anesthesiol Clin, 2015, 33 (3), 517-550.

[32] Rasmussen LS, Johnson T, Kuipers HM, Kristensen D, Siersma VD, Vila P et al. Does anesthesia cause postoperative cognitive dysfunction? A randomized study of regional versus

general anesthesia in 438 elderly patients. Acta Anesthesiol Scand, 2003, 47 (3), 260-266.

[33] Gultekin S, Ozcan S. Does hearing loss after spinal anesthesia differ between young and elderly patients? Anesth Analg, 2002, 94 (5), 1318-1320.