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Surgery of the Elderly Patient

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The world population is becoming older. As many diseases that require surgery also increase with age, surgeons have to become familiar with special issues that are unique to elderly patients requiring surgery. This review highlights the perioperative care of the elderly patient.

Key words: Surgery – Elderly

Life expectancy has increased. According to the National Institute on Aging, National Institute of Health, and World Health Organization report in October 2011, the number of people aged 65 or older is projected to grow from an estimated 524 million in 2010 to nearly 1.5 billion in 2050, with most of the increase in developing countries.[1] As a result, the conditions that require surgery, such as atherosclerosis, cancer, arthritis, prostatism, and others, also increase.[2] This has changed the definition of the elderly for the surgeons, where a threshold of 50 years was chosen in 1907, and surgery was not warranted even in this age group[3,4]; a growing number of complex operations are being performed to patients even over 80 years of age with success today.

Aging is a physiologic process where the structure and functional capacity of organs and tissue progressively degenerates over time.[5] The human body has the capability to compensate for age-related changes to some extent, but either healthy or sick, elderly people have a limited physiologic reserve that can become evident on application of stressors,[6] which is why the knowledge of the physiologic changes of the elderly is essential when planning surgery for the elderly patient.

Physiologic Changes of the Elderly

Cardiovascular system

The increase in elastin and collagen causes a decrease in myocytes. The resulting increase in the fibrotic areas throughout the myocardium causes a decrease in ventricular compliance. Extracellular matrix, which is important in myocardial performance, may be altered or dysregulated.[7] Fibrosis in the conducting system may increase the vulnerability to arrhythmia. The valvular rings may be dilated. Increase in rigidity and decrease in distensibility in peripheral circulation may lead to increased systolic blood pressure and ventricular hypertrophy. Cardiac output and ejection fraction are maintained despite the hyposympathetic state of aging by which the heart becomes less responsive to catecholamines. This maintenance is established mostly by increased preload. As preload is

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important for systolic function, even minor hypovolemia can cause significant compromise in cardiac function and because myocardial relaxation is more energy dependent, even mild hypoxemia can result in prolonged relaxation, higher diastolic pressures, and pulmonary congestion.[8] Manifestation of cardiac diseases in the elderly may be nonspecific and atypical. Although chest pain is still the most common symptom of myocardial infarction, there may be nonclassical presentation such as shortness of breath, syncope, acute confusion, or stroke.

Congestive heart failure is the leading cause of morbidity and mortality after surgical procedures of the elderly. Preoperative recognition of impaired cardiac function and reserve is essential to maintain proper fluid balance and limit myocardial stress. Estimation of cardiac reserve may be difficult because most elderly patients with cardiac dysfunction are in a compensated state and only show signs of disease when stressed. Lately, increase in the N-terminal pro-brain natriuretic peptide level is shown to be associated with heart failure, atrial fibrillation, and cardiovascular mortality.[9]

Patients with coronary artery disease are at particular risk for perioperative myocardial ischemia. Tachycardia and hypertension during the operation may increase cardiac work and decrease coronary blood flow, causing ischemia. Implementation of β-adrenergic blocking agents should begin before a planned procedure and be continued throughout the perioperative period. Intraoperative intravenous nitroglycerin dilates the coronary circulation, reduces cardiac stress, and prevents myocardial ischemia.

Respiratory system

Intrathoracic volume displacement of the lung decreases because of the loss of elastic recoil of the lung and impaired chest wall movement due to the muscle atrophy. Impaired elasticity also causes air trapping and ventilation-perfusion mismatching, leading to decreased oxygen transfer and increased alveolar-arterial oxygen gradient. Oxygenation is additionally impaired by an increased closure volume of small airways and decreased surface area for gas exchange as lung parenchyma is destroyed. Vital capacity decreases with age, reflecting an increase in dead space ventilation. Forced expiratory volume in 1 second (FEV1) decreases, resulting in a FEV1:vital capacity (VC) ratio <70. Uneven alveolar ventilation leads to ventilation-perfusion mismatches and a decrease in arterial oxygen tension. The pCO_2 does not change despite an increase in dead space. This may be due to the decline in the production of CO_2 that accompanies the falling metabolic rates. Residual volume increases, functional residual capacity increases, and total lung capacity remains unchanged.

The control of ventilation is also affected by age. Ventilatory responses to hypoxia and hypercapnia fall by 50% and 40%, respectively. This may be the result of declining chemoreceptor function at either the peripheral or central nervous system level. In addition, pulmonary function is affected by alterations in the ability of respiratory system to protect against infection. There is a decline in mucociliary clearance and decrease in several components of the swallowing function. The loss of the cough reflex due to neurologic disorders combined with swallowing dysfunction may predispose an elderly patient to aspiration. The increased frequency and severity of pneumonia in older persons has been attributed to these factors and to an increased incidence of oropharyngeal colonization with Gram-positive organisms.[8]

Renal system

Total body water decreases, glomerular filtration rate decreases, urinary concentrating capacity decreases, antidiuretic hormone increases, atrial natriuretic peptide increases, aldosterone decreases, thirst mechanism decreases, and free water clearance decreases. Aged-related changes in the renal system are characterized by a progressive reduction in renal mass caused by glomerulosclerosis, leading to decreased creatinine clearance in most aged patients. Slowed drug elimination can lead to prolonged sedative effects of anesthetic and narcotic medications and a propensity to drug-induced acute renal failure after administration of nonsteroidal anti-inflammatory medications, diuretics, and antibiotics. The plasma level of creatinine may measure low in elderly patients because of reductions in skeletal muscle mass, and calculated creatinine clearance remains the most sensitive marker of renal function.

Renal tubular function also declines with advancing age. The ability to conserve sodium and excrete hydrogen ion falls, resulting in a diminished capacity to regulate fluid and acid-base balance. Dehydration becomes a particular problem because losses of sodium and water from nonrenal causes

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are not compensated for by the usual mechanisms of increased renal sodium retention, increased urinary compensation, and increased thirst. The inability to retain sodium is believed to be due to a decline in end-organ responsiveness to antidiuretic hormone (ADH). The marked decline in the subjective feeling of thirst is also well documented but not well understood. Alterations of osmoreceptor function in the hypothalamus may be responsible for the failure to recognize thirst despite significant elevations in serum osmolality.[8]

Gastrointestinal system

Esophagus

Age affects both the phrenoesophageal swallow mechanism and esophageal contraction. As a result of slowed vestibule closure, maximal hyolaryngeal excursion and delayed upper esophageal sphincter opening due to mechanical and neurologic components swallowing slow and the risk of aspiration increases.[10–13]

Stomach

Although the effect of age on gastric emptying is questionable, it is clear that *Helicobacter pylori* infection may lead to atrophic gastritis and intestinal metaplasia, resulting in bacterial overgrowth and malabsorption. These, in turn, may lead to diarrhea, lower body weight, lower plasma albumin and vitamin B_{12} levels, and malnutrition. The state of cellular hyperproliferation and decreased apoptosis along with increased exposure to carcinogens may increase the incidence of gastric cancer in the elderly.[13–15]

Intestine

The mucosal histology and absorption capacity of the small intestine is protected during aging[16]; however, a series of changes occur concerning large intestine. Along with the factors like chronic illness, opiate use, polypharmacy, and dietary changes, age-related loss of inhibitory nerve input to the circular smooth muscle of the colon and prevention of colonic relaxation or decrease of the normal inhibition of nonpropagating colonic contraction may result in constipation among the elderly.[17] Fecal incontinence may be due to affected sphincter function or rectal impaction causing overflow incontinence.[18] Abnormal motor or propulsive activity may lead to formation of diverticular disease, and various forms of colitis seem to increase with age.[13,19]

Liver

Although a functional impact or effect on liver function tests and metabolic function is not expected, the liver size decreases with age as the number of hepatocytes and hepatic blood flow also decrease; however, cell volume, ploidy, and organelle constituents increase.[13,20,21]

Principles of Surgery of the Elderly Patient

The clinical presentation of surgical problems in the elderly may be subtle, and this may lead to delay in diagnosis. The elderly handle stress satisfactorily but handle severe stress poorly because of the lack of organ system reserve. The results of elective surgery in the elderly are reproducibly good; the results of emergency surgery are poor, although still better than nonoperative treatment for most conditions. A patient's age should be treated as a scientific fact, not with prejudice, and no particular chronologic age is a contraindication to operation. Attention to detail intraoperatively and perioperatively yields great benefit as the elderly tolerate complications poorly. Therefore, the optimal preoperative preparation is essential because, when preparation is suboptimal, the perioperative risk increases.[2]

Preoperative evaluation

While evaluating a patient before surgery, the changes induced by the process of aging, the cumulative impact of coexisting diseases, functional and nutritional status, presence of drug use, difficulties in communication and comprehension as reduced hearing or vision, falls, incontinence, compromised cognitive function, and a consideration whether the patient can provide informed consent all should be taken in to account because 3 factors are important to mortality and other clinically relevant clinical outcomes during the clinical decision making of the elderly patient.[22,23] These are the presence of comorbidities, disability, and frailty. Comorbidity is the clinical manifestation of illness in an individual such as cardiac, pulmonary, or renal diseases. Disability is defined as difficulty in carrying out activities that are essential for independent living such as bathing, dressing, and eating, and frailty in the elderly refers to patients with poor physiologic reserve who are at an increased risk of adverse events following exposure to stressors such as anesthesia and surgery. Frailty criteria include slow gait speed, low physical activity, unintentional weight loss, self-reported exhaustion, and muscle

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weakness.[24] These can be helpful to identify patients at greatest risk of postoperative complications, mortality, disability, and cognitive decline, thus helping to seek methodologies to prevent or decrease these results.

No evidence supports a single standard presurgical assessment for the elderly.[25] Preoperative screening should be guided by the type of surgery and the underlying comorbidities rather than a routine list of tests.[26] Cardiac, pulmonary, liver, and renal function, as well as electrolytes and nutritional status, should be evaluated as with the other patients but taking the physiologic changes of age in to account. Urinalysis and identification of unknown urinary tract infection are important to prevent complications.

Many elderly people are on a number of medications. Most of the cardiac medications including statins and beta blockers can be used safely, but angiotensin converting enzyme inhibitors and angiotensin receptor blocking drugs should be stopped because of the risk of hypotension.[27] Stopping carbidopa and levodopa for Parkinson's disease can lead to a return of symptoms, so they should be started as soon as possible, and oral hypoglycemics should be discontinued before surgery.

While operating on an elderly patient there are other issues of concern, such as the prophylaxis for venous thromboembolism, care for cardiac problems, aspiration and infection, bowel preparation, and positioning the patient.

Age itself is an independent risk factor for venous thromboembolism, so the use of either intermittent pneumatic compression or pharmacologic prophylaxis is essential to help prevention. It should be kept in mind that dose adjustment may be needed for low-molecular-weight heparin because of the reduced renal clearance. For intermediate- or high-risk patients for perioperative cardiac events, beta blockers may be used, and appropriate use of the antibiotics and timely intubation of the patient are important for the prevention of infection and aspiration.

The elderly patient may have rheumatologic, orthopedic, or neurologic diseases either necessitating or complicating the surgery; that is why sloppy positioning of the patient may cause tissue or nerve injury, even fractures. Besides, the tissue mass loss with age increases the risk of pressure injury and subsequent decubitus in the elderly, so the use of support material may be necessary when indicated.[28]

Postoperative care

Postoperative care of the elderly patient is extremely important for both decreasing the short- and long-term mortality of the patients and improving the quality of life. There are no standard guidelines for postoperative care of the elderly patient. The care is similar to other patients with special concerns for the respiratory and cardiovascular systems, taking into account the physiologic changes and comorbidities. Also, good oxygenation and hydration of the tissues is necessary for wound healing, so hypoxia, hypovolemia, and hypervolemia should be avoided. Above all, the following are worth mentioning when working with elderly patients: hypothermia, pain control, mobilization, rehabilitation, fall prevention, prevention of postoperative delirium and cognitive dysfunction, and intolerance to complications.

Hypothermia

Elderly people are at greater risk of perioperative hypothermia immediately after surgery owing to a basal metabolic rate that declines 1% to 2% per decade starting at 20 years of age, as well as the decreased physical activity of many elderly people.[29] The effect of adjusted temperature on intracellular metabolism, inflammation, and coagulation systems should not be forgotten.

Pain control

Apart from the postoperative reasons, elderly patients may have pain due to preexisting chronic diseases; muscular, skeletal, and neural stretches and pain is generally undertreated in the postoperative elderly patient because of fears of impairment of cognitive function, respiratory function, and dependency, but may be mostly because of errors of assessment. Visual analogue scale and models rating the pain numerically or verbally can be used to assess the pain of the elderly; however, failure to move in bed or ambulate, lack of appetite, or depressive affect may be the other clues. Opioids remain the mainstay of pain management. The elimination half-life of morphine may be lengthened in older people due to reduction in clearance and protein binding, but fentanyl has no active metabolites and can be safely used for elderly people. Other than the known side effects, constipation, nausea, and vomiting may be more problematic for elderly people on opioid medication, so the use of the least amount of narcotic to achieve good pain control is the rule, and multimodality pain medications can be used to reduce the need for more

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narcotic medications. The use of nonsteroidal anti-inflammatory drugs can be problematic because of their potential renal toxicity, and acetaminophen and local and topical anaesthetics can be the other components of multimodal therapy. Patient-controlled analgesia may provide good pain relief and high satisfaction.[30,31]

Mobilization, rehabilitation, and prevention of falls

These are quite important during the postoperative care of elderly patients. Multiple conditions such as preoperative orthopedic, ophthalmic, and neurologic conditions, as well as medications, anesthesia, cognitive impairment, and poor control of pain, may cause mobilization problems. Early and increased mobility improves respiratory and cognitive functions and helps to avoid the thrombotic effects, so every effort should be used to support patient mobilization in the early and late postoperative period, both in and out of the hospital.[32]

Postoperative delirium

Postoperative delirium is an acute organic brain syndrome that usually develops within the first postoperative days.[33] It can be seen in approximately 15% of the elderly patients after elective operations, and emergent and major surgery may increase the incidence up to 70%.[34] Advanced age, preoperative cognitive impairment, preexisting medical disease, and genetic factors such as apolipoprotein E4 phenotype may predispose the condition, whereas infection, inflammation, metabolite disturbances, substance withdrawal, medications, discomfort, environmental disturbances, sleep disruption, or severe pain may act as eliciting factors.[35] Although the pathophysiology of postoperative delirium is not well understood, it may be related to disturbances in the production, release, or inactivation of neurotransmitters or modulation of the inflammatory signaling system.[36] Symptoms are disturbance in consciousness such as reduced clarity of awareness, reduced ability to focus or sustain attention, reduced awareness of the surrounding environment, and cognitive changes such as memory deficit, disorientation, language disturbances, and perceptual disturbances as hallucinations. Prevention should be aimed at eliminating the eliciting factors, and, when necessary, pharmacotherapy with haloperidol may be needed.[37] Postoperative cognitive dysfunction is a subtle deterioration of daily cognitive performance with a wide spectrum of neuropsychologic domains of memory, psychomotor speed, information processing, and executive functions. The etiology and pathophysiology may be similar to postoperative delirium, and both may have long-term postoperative effects, increasing the social and economic burden, as well as mortality.

Importance of complications

Because of the decreased reserve, complications are not well tolerated by elderly, as reflected in the adage "they tolerate the operation, but not the complications." Pulmonary and infectious complications especially increase mortality, so prevention and early treatment are highly important.[38,39]

Conclusion

Surgery in the elderly patient is rising. As complications are not well tolerated by elderly, every effort should be used to prevent them; this necessitates the knowledge of physiologic changes, definitions, diagnosis, and good evaluation during the perioperative period.

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