Anesthesia and the aged

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By the year 2030, the elderly will represent 18.3% of the general population in the United States as compared to 11% today. The author reviews the changes associated with the aging process, the anesthetic considerations involved, and the basic perioperative care necessary.

Introduction

Statistics published in 1978 by the then named United States Department of Health, Education, and Welfare indicate a startling rise in the numbers and percentages of the elderly in this country. In 1900, there were 3.1 million persons over 65 in the United States, representing 4.1% of the general population. In 1975, there were 22.4 million persons over 65, representing 10.5% of the general population. In the years between 1900 and 1970, there was a seven-fold increase in the aged population, as compared to an increase in the general population of only 2.5 times. By the year 2030, the elderly will represent 18.3% of the general population (the figure is approximately 11% at present).

In terms of health care, this 11% accounts for 29% of total personal health care expenditures. In addition, the following factors give insight into the role of the elderly as health care consumers:

1. Older persons have about twice as many hospital stays, and these last almost twice as long as those of younger persons.

2. As leading consumers of pharmaceuticals, the elderly receive 25% of all prescriptions and a larger percentage of non-prescribed medications.

3. Medication and other therapeutic and diagnostic efforts account for a considerable percentage of illnesses in the elderly (that is, iatrogenic illness).

4. In fiscal year 1977, the cost of health care for those over 65 averaged approximately $1,745; this is more than three times the cost for those under 65.

5. Although the majority of the elderly are self-sufficient, ambulatory, and mentally alert, over 80% have reported some chronic condition.

6. In most hospitals, the elderly comprise approximately 33-60% of all patients in acute care medical-surgical wards.

These statistics illustrate, rather dramatically, the fact that anesthetists will be seeing an increasing number of elderly patients being brought to surgery for both emergency and elective procedures. Therefore, a thorough understanding of the physiologic effects of aging, and the problems associated therein, is necessary for optimal anesthetic care.

Physiologic changes of aging

Assessing baseline data concerning the state of the geriatric patient's health requires a working knowledge of the "normal" aging process. Certain deviations from the normal may appear pathological to the practitioner unaware of changes consistent with senescence. Difficulty may be en-
countered when attempting to delineate normal from pathological. For example, osteoarthritis, arteriosclerosis, Parkinson’s disease, and possibly senile dementia may be categorized as “outward manifestations of biological changes met within old age and they cannot, therefore, be considered diseases in the ordinary sense.”

There exist two basic schools of thought regarding the cause of aging, and it appears that both may play a part in the normal aging process. The general pattern of aging among species seems to be accounted for by genetics. This theory regards aging as a predetermined event, individually inherited. The other theory regards aging as the cumulative effect of accidents in protein synthesis, occurring over a lifetime. This latter theory may, in fact, explain variations in life span and the aging process, unaccountable in terms of pure genetics.

The nervous system

Brain weight decreases with age. This is a result of atrophic changes which are more marked in the frontal halves of the cerebral hemispheres. In addition, the overall number of neurons decreases, especially in the cerebral cortex. This may result in neurofibrillary tangles and interference with basic neuronal processes. Memory loss and/or senile dementia are both problems associated with these changes.

Assessment of mental status preoperatively may reveal recent personality changes, disorientation, or forgetfulness. Inappropriate responses during the preoperative interview require investigation to elicit a cause. Hearing loss, organic brain syndrome, or residual asphasia from a stroke should be considered.

A history of stroke is an important index of the degree of atherosclerosis present and the brain’s tolerance to it. Several anesthetic considerations include: (1) the avoidance of agents or techniques which characteristically produce significant changes in blood pressure, (2) the maintenance of ventilatory control of CO2 tension (lowered PCO2 decreases cerebral blood flow), (3) the protection of palsied or paralyzed extremities during positioning, and (4) the possibility of prolonged deafferentation following spinal anesthesia.

The patient with chronic brain syndrome can be considered to have partially-induced anesthesia and will require a lower dose or concentration of general anesthetic drugs to achieve clinical anesthesia.

Sensory changes include significant alterations in all five senses. Decreased accommodation to light and an inability to distinguish between various intensities of light may result in accidents, leading to injury. Density increases in the optic lens result in cataracts, while a loss of elasticity of the lens results in presbyopia. A change in aqueous kinetics commonly results in glaucoma and increased intraocular pressure. Care should be taken to protect the eyes against pressure on the globe in the patient with glaucoma. Controversy exists regarding use of belladonna alkaloids preoperatively in the presence of glaucoma. Dripps states, “Except for the narrow-angle variety, glaucoma does not contraindicate their [atropine and scopolamine] use, since a rise in intraocular pressure does not occur unless the usual clinical doses are exceeded.”

The sense of smell is impaired in four out of five subjects over the age of 65. Sense of taste dysfunction, closely allied to that of smell, is in the same proportion. Weight loss may be an associated problem. Anatomical changes in the inner ear, otosclerosis, or impacted cerumen may result in presbycusis, a high-frequency hearing loss associated with age. Decreased response to pain sensation and temperature changes, as well as an increased pain threshold may lead to accidents or burns.

With age, there is an increased activity of the monoamine oxidase enzyme with resultant depression; the depressed elderly may be treated with an MAO-inhibitor. Any MAO-inhibitors must be discontinued one to two weeks prior to surgery. Potentiation of central nervous system depressants, such as anesthetics, narcotics, barbiturates, or alcohol, may occur. Additionally, hypertensive crises may develop if endogenous catecholamines are released by the administration of certain vasoressors (such as, ephedrine or amphetamine).

Cardiovascular system

The most common pathologic changes in old age are diseases of the cardiovascular system. Cardiovascular reserve clearly diminishes with age in normal individuals. This may occur without a decline in contractility or cardiac output. There is also a normally occurring left ventricular hypertrophy with age. This may be a result of a higher peripheral resistance due to thicker elastic fibers in the walls of large arteries. A resultant decrease in compliance in these vessels most probably leads to a well-documented increase in blood pressure with age.

Other cardiovascular changes associated with age include:

1. A 20% reduction in maximum heart rate response to dynamic exercise at age 75 as compared to that of a 20-year-old.
2. A diminished baroreceptor reflex leading to postural hypotension.

3. A progressive deterioration of both the intima and muscle layers of the vasculature, characteristic of arteriosclerotic changes.

4. An increase in valvular calcification, leading to aortic or mitral murmurs, endocarditis, or valvular stenosis and/or insufficiency.

5. Sclerosis of the conduction system leading to a degree of heart block.

Anesthetic considerations for these changes are varied and complex. Generally speaking, the margin of error in cardiovascular function is decreased in the aged.

A patient in frank congestive heart failure is not a candidate for elective surgery. Full compensation and stability on a maintenance dose of digitalis must be reached before the patient is subjected to an anesthetic and surgery. In an emergency situation, digitalization should be started and, if possible, improvement should be exhibited prior to induction of anesthesia. In cases such as this, it is better to err on the side of too little digitalis than too much. Electrolyte changes incidental to the body's response to surgical trauma (such as hypokalemia or hypomagnesemia) predispose to digitalis toxicity; more digitalis can always be given if necessary.

Criteria for digitalis administration preoperatively are varied and debatable. Congestive heart failure, as stated, is a generally accepted circumstance. Another widely accepted circumstance is atrial fibrillation with rapid ventricular response. Yet another, and not so generally accepted rule is digitalization of the patient with a history of previous digitalis therapy. In this case, one-half to two-thirds the predicted digitalizing dose should be used.

Myocardial infarction in the history of an aged surgical patient significantly affects anesthetic risk. Hospital mortality rates of up to 40\% have been reported in patients undergoing surgery within three months after infarction. The greatest risk appears to be in the first 15 days after infarction. In the following 21/2 months, mortality rates are the same for both medical and surgical patients. This indicates little reason for prolonging essential surgery at this point. Knapp and associates concluded that two years post-infarction, the surgical risk is decreased to that of patients of the same age with no history of heart disease.

Preoperative electrocardiography is essential in all patients over 65. This may be useful as an assessment tool for present status as well as a reference in regard to past and future ECG's. Frank ischemic patterns (inverted U-waves, S-T depression or elevation, or T-wave flattening) require serial tracings before elective surgery. PAC's (premature atrial contractions) should be considered a benign finding unless they occur frequently, in which case impending atrial fibrillation or supraventricular tachycardia may be indicated. AV block, of any degree, indicates ventricles receptive to ectopic foci. Frequent PVC's (premature ventricular contractions) in the preoperative period, when not associated with other dysrhythmias or symptoms, usually do not require treatment. PVC's often become less frequent or disappear altogether during general anesthesia.

For patients receiving antihypertensive medication, vascular response may be measured by review of preoperative pulse rate and blood pressure. A variation of 20 beats/min or 20 mmHg in the systolic blood pressure indicates acceptable vascular reactivity. A fixed pulse rate, with little variation in blood pressure, increases the risk of hypotension episodes intraoperatively in the patient on hypertensive medication. Thiazide diuretics, given in conjunction with antihypertensives, require preoperative evaluation of serum electrolytes, particularly potassium, and replacement therapy should be begun, if below 3.0 mEq/L.

**Respiratory system**

Aging alone increases the relative risk of postoperative pulmonary complications by 3:1. The ability of the lungs to perform their primary duty, that is, oxygenation and removal of CO\(_2\), is hampered by several physiologic changes associated with age. These include a combination of increased anteroposterior diameter of the chest wall, weakening of the respiratory muscles, reduction in recoil pressure, and an increased stiffness in the thoracic cage. All of these factors tend to decrease respiratory reserve and the efficiency of alveolar-capillary gas exchange.

While alveolar PO\(_2\) remains relatively constant throughout life, arterial PO\(_2\) decreases with age. Men at age 20 have a higher mean arterial PO\(_2\) than that of women of the same age. However, a more rapid reduction in arterial PO\(_2\) in men (0.43 torr/year) than in women (0.31 torr/year) equalizes mean arterial oxygen tension by age 70.

Septal membranes weaken and stretch with age and an enlargement of the alveoli takes place. This enlargement reduces total surface area available for exchange. A loss of elastic recoil forces airways to close at a higher volume. Residual lung volumes increase at the expense of vital capacity, until the mean residual volume at age 60 is approximately...
118% of that value at age 20. Additionally, an increased production and a decreased ability to eliminate tracheobronchial secretions will interfere with gas exchange, while also predisposing to atelectasis and bronchopneumonia.

Anesthesia reduces the efficiency of alveolar-capillary exchange due to increased shunting, inequality of ventilation/perfusion ratios, and increased physiologic dead space. Hypoventilation or inadequate oxygen concentration may further reduce this ability. These factors, in addition to the normal aging process, place the geriatric surgical patient at particular risk.

Preoperative assessment of respiratory status is a most important anesthetic consideration. Appearance and breathing patterns are excellent indicators of significant pulmonary disease. The patient in a relaxed position, able to speak in complete sentences, without stopping to take a breath, is most probably free of disabling pulmonary disease. On the other hand, a “military” posture or slight bend forward, poor breath control during speech, or pursing of the lips with each expiration, are all signs of chronic breathing problems. A history of many years exposure to dust or fumes, chronic productive cough, or heavy cigarette smoking indicates a need for preoperative pulmonary function studies.

If the patient is being treated for emphysema, bronchitis, or asthma, the anesthetist should know the regimen of treatment and drug dosages used. The asthmatic patient whose first symptoms appeared after age 50 has a poor prognosis. Anesthesia should be based on prevention of an asthmatic attack, as response to therapy is poor, and complete relief from status asthmaticus is rare.

Pulmonary function studies should revolve around the forced expiratory vital capacity (FEVC). This test measures both volume and the ability to move that volume. Results indicative of obstruction should be followed by intermittent positive pressure breathing (IPPB) therapy, with bronchodilators, postural drainage, and chest physical therapy. Substantial improvement should be noted prior to the administration of general anesthesia in elective procedures. Oxygen tension via analysis of arterial blood gases will most often appear in the 70-85 torr range and these values may be normal for the aged patient. Carbon dioxide tension and pH, however, should be in the normal range, as in the general population.

Intraoperative respiratory anesthetic considerations include positioning, delivered oxygen concentration, method of ventilation, and volume delivered. Craig, Wahba, and Don have shown an increase in residual volume and airway closure in the supine and lithotomy positions. The decrease in alveolar-capillary exchange warrants an increase in O2 concentration delivered. In addition, if an assist-mode of ventilation is used, the decrease in compliance increases the work of breathing and, therefore, increases oxygen consumption. Higher inflation pressures are usually necessary in light of this decrease in compliance. These pressures may interfere with venous return, cardiac output, and pulmonary capillary filling. The increase in dead space may also indicate a higher ventilatory requirement to achieve adequate alveolar ventilation.

Genitourinary system

Renal mass and function progressively decrease with advancing age. An additional reduction in renal blood flow is a result of decreased cardiac output and a smaller vascular bed. The renal cortex is the primary site of this mass reduction and is secondary to intrarenal vascular changes with age. A resultant decrease in glomerular filtration rate (GFR) and tubular function occurs. Between the ages of 20 and 90, a 46% decrease in GFR is seen. Normal GFR at age 40 is 120 ml/min and this will fall to 60 or 70 ml/min at age 85.

Derangement of extracellular fluid volume is common in the elderly and will delay recovery and prolong hospitalization. This derangement is a result of a sluggish response to sodium deficiency. Inadequate salt intake due to confusion or dietary deficiencies is more slowly compensated by renal conservation of sodium in the aged. A reduction in plasma aldosterone levels aggravates this sodium loss and contributes to a degree of hyperkalemia. Through its action on the distal tubule, aldosterone increases sodium reabsorption and facilitates the excretion of potassium. A lowered GFR will also contribute to this tendency toward hyperkalemia. Elderly patients are unable to concentrate their urine in light of decreased water intake. BUN values will rise from 9.5 mg/100 ml at age 20 to 15-20 mg/100 ml at ages 70-80.

The fluid and electrolyte status in the healthy-looking geriatric patient presenting for elective surgery can be considered normal if routine laboratory values are within normal limits. However, the aged patient who presents with a broken hip following a fall in a nursing home or in his own home (where the patient may live alone) must be considered a higher risk for fluid and electrolyte disturbances. Reduced fluid intake, confusion, and the translocation of extracellular fluid into the injured area make this individual susceptible to volume-related complications. An additional anes-
thetic consideration related to renal function is the probability of prolonged plasma half-lives of those drugs dependent upon renal excretion.

Miscellaneous changes
While central nervous system (CNS), cardiovascular, respiratory, and renal changes may be considered major, a list of other miscellaneous physiological alterations must also be considered.

Increasing incidence of peridontal diseases in the aged causes teeth to become mobile and fragile to the point of removal. Preoperative removal of loose teeth should be considered since fracture or dislodgement may occur intraoperatively. Removable prostheses should be taken out of the patient's mouth prior to intubation; care should be taken to return these to the patient postoperatively.

Basal metabolic rate decreases with age. This is thought to be a response to the replacement of metabolically-active tissue with relatively inert fibrous and connective tissue over the years. Muscle mass is decreased. Subnormal body temperatures are closely related to environmental temperatures (poikilothermic). An excessive fall in body temperature may result with exposure to an even moderately cold environment. An abnormality in the temperature regulatory mechanism is thought to be partially at fault for this cold intolerance.

Osteoporosis and osteoarthritis occur when the density of the bone decreases. Estrogen deficiency in women after middle age, insufficient dietary intake, and possible abnormalities in calcium, protein, and amino-acid metabolism all contribute to this state.

Decreased motility of the stomach and intestines, reduction in intestinal blood flow, an increase in gastric pH, a decrease in the quantity of absorbing cells, and modification of the active transport system all lead to a degree of constipation. These factors may also delay or reduce orally-administered drug absorption. In addition, reduced hepatic blood flow and enzyme activity will slow metabolism of some drugs.

Iron deficiency anemia, caused by malnutrition and malabsorption, and anemias due to chronic diseases such as infection, arthritis, or malignant disease may affect oxygen-carrying capacity. Lloyd studied 100 patients in a geriatric assessment clinic in Scotland and found 20% to be anemic.

Pharmacologic considerations
In anesthesia, the administration of a variety of medications is a fundamental requirement. Knowledge regarding the absorption, distribution, and elimination of administered medications in the geriatric patient is of particular concern, as expected responses may be altered. Hurwitz found in 1969 that, among hospitalized patients, adverse reactions to drugs administered occurred in 21.3% of patients over 70 years of age, with only 3% in patients between 20 and 29 years of age.

Absorption of medication from the gastrointestinal tract is delayed by those factors discussed as changes in gastrointestinal (GI) function. An additional note should be made regarding the age-associated increase in gastric pH. Acidic drugs administered orally will ionize in a more alkaline environment, making passive diffusion across cellular membranes more difficult.

GI motility will also affect drug absorption. Many elderly patients equate good health with regular bowel movements and will overuse laxative preparations. This will decrease absorption by artificially speeding motility, and hence, passage through the GI tract. These changes make oral or rectal administration less reliable than that of parenteral.

Drug distribution is affected by changes in body composition and plasma proteins. The percentage of body composition that is fat increases while that percentage representing lean body mass and total body water decreases with age. Therefore, water-soluble agents, such as alcohols, will have smaller volumes in which to distribute (Vd — volumes of distribution). This leads to higher blood and lean tissue levels. On the other hand, the decrease in lean body mass will change the volume of distribution of sodium pentothal, a lipid-soluble substance, in fat deposits and prolong its clinical action. Another physical change affecting drug distribution is a general decrease in plasma albumin. This change results in an increased amount of free, or unbound, drug in the plasma. The clinical action of d-Tubocurarine and pentothal will be exaggerated via this mechanism.

Drug metabolism is predominantly a result of liver and microsomal enzyme activity. With aging there is a progressive decrease in hepatic blood flow and, most probably, enzyme activity. Studies in animals have shown less activity of liver microsomal enzymes in the aged, but the effects of human aging have not been determined.

As previously discussed, a decrease in renal function is inherent with aging. This infers a decrease in drug elimination. This decrease in renal clearance may cause an increase in plasma drug concentrations, thus prolonging the half-life and possibility of toxicity of the drug. Drugs to which particular attention should be paid are antibiotics, such as penicillin, tetracyclines, and

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aminoglycosides, and cardiotonics, such as digitalis and quinidine. Gallamine, eliminated unchanged via the kidneys, may have a prolonged neuromuscular blocking effect in the elderly patient.

The elderly appear to be more sensitive to the effects of certain CNS depressants. Vestil, in a large double-blind study utilizing standard doses of morphine and pentazocine, showed a progressive increase in effectiveness of these drugs, as measured by relief of pain intensity. This study suggests that a decreased pain perception may exist in older patients, and that lower doses of potent analgesics may be required. Greenblatt and associates, in a large study using flurazepam (Dalmane®), showed an incidence of adverse reactions, primarily CNS depression, nearly four times as great among those over 80 years of age when compared to those under 60.

Anesthetic management: Preoperative evaluation

Today, no patient is too old to tolerate anesthesia. Although most studies confirm that mortality increases with age, well conducted anesthesia may, in fact, prolong life. Cogbill, in a study of mortality following abdominal surgery, found significantly lower mortality rates when surgery is performed as an elective procedure. The exceptions to this general rule are uncontrollable hemorrhage, major vessel emboli, or intestinal obstruction. A decrease in perioperative morbidity and mortality will result when time is taken preoperatively to correct those concurrent disease processes more likely to appear in the aged, that is, hypertension, congestive heart failure, cardiac dysrhythmias, chronic obstructive pulmonary disease (COPD), or diabetes. On the other hand, well-intentioned but misguided postponement of surgery in an attempt to reverse long-standing atrial fibrillation or COPD, may do more harm. A balance, therefore, must be drawn between undue haste and unnecessary postponement.

The objectives of the preoperative visit are as follows:

1. To evaluate the patient's general condition, both physiological and psychological. A detailed examination of available data (history, physical, laboratory data, ECG's, x-rays) is used to accomplish this task. In the physical examination, particular attention should be accorded the head, neck, cardiovascular, and respiratory systems.

2. To determine, by talking with the patient, pertinent information regarding previous anesthetics, allergies, or personal data. An opportunity to ask questions should be provided, as well as a possible preference toward an anesthetic technique. A calm, factual discussion regarding the anesthetic choice, its risks and benefits, may help alleviate anxiety.

3. To aid in determining the need for additional diagnostic procedures or treatments (pulmonary function studies, ABG's, ECG).

4. To order preanesthetic medication. Elderly patients may have trouble sleeping in the hospital and it may be necessary to order a sedative at bed time. The patient may, in fact, take a "sleeping pill" at home. If possible, the same medication and dosage should be made available to him while he is in the hospital.

The choice of preoperative medication should revolve around the standard goals of preanesthetic medication. These are: alleviation of apprehension, reduction of secretions, and facilitation of induction and maintenance of anesthesia. Narcotics should be used preoperatively only if the patient has pain, in a dose reduced by one-third to two-thirds the usual adult dosage. An enhanced depression of the respiratory center is believed due to the decrease in the number of nerve cells, therefore, conservative doses of barbiturates or sedatives should be administered orally or intramuscularly.

The use of belladonna alkaloids preoperatively is under question in the geriatric patient. These agents make the more viscous respiratory secretions in the aged difficult to remove or expel. Should vagal responses become apparent during anesthesia, these drugs may be given intravenously with good results.

Intraoperative considerations

The choice of anesthetic techniques and agents is, of course, a combination of knowledge of desired physiological effects and personal preference. The information contained in the previous pages will guide the anesthetist toward that technique most favorable for the aged patient.

Regional anesthesia is the choice of many practitioners when presented with a patient who is a fair to poor risk (ASA status III, IV, or V). Agents used for regional anesthesia are considered a matter of personal preference. It may seem illogical to anesthetize the entire body of a poor risk patient when only a portion requires anesthesia. Upper extremity operations and extraperitoneal operations below the umbilicus can be done most easily under regional anesthesia.

Brachial block, utilizing the axillary approach, usually provides excellent conditions for surgery on the arm. Intravenous regional anesthesia may
also be used if the patient's veins can tolerate (without tearing) the pressure created by the tourniquet.

When used correctly, spinal anesthesia is one of the safest techniques for the geriatric patient. It is many times more dependable, more predictable, and takes less time to induce. It does, however, have considerable risk and disadvantages for the geriatric patient. A preganglionic blockade of sympathetic vasoconstrictor fibers leads to a degree of hypotension. The extent of this vasodilatation is directly related to the number of sympathetic segments paralyzed. Provided the subarachnoid block is limited to spinal segments below T-8, the resulting hypotension is easily controlled with vasopressors. Spinal analgesia below L-1 usually does not lower blood pressure. It is, therefore, recommended that spinal anesthesia be limited to operations below the umbilicus (T-10).

Another disadvantage of spinal anesthesia is a relatively frequent difficulty in administering the lumbar puncture, due to calcified ligaments and ankylosed joints. Spinal anesthesia is most often used for inguinal hernia repairs, anorectal procedures, prostatic resections, hip pinnings, and leg amputations. The response of the geriatric patient to general anesthesia is altered in many ways. Concentrations and amounts hardly analgesic in the young may cause severe cardiovascular and respiratory depression in the elderly. Absorption, distribution, and elimination of anesthetic agents, both inhaled and injected, are hampered by the age-associated changes in respiratory and cardiovascular status.

Induction agents include sodium thiopental, methohexital, diazepam, and volatile liquids. Because thiopental is a cardiac depressant, it must be administered with extreme caution to the geriatric patient. Slow injection, in conservative doses, is the best protection against this depression. Diazepam, as an alternative to thiopental, results in less cardiovascular depression. The intubation dose of succinylcholine is 1 mg/kg IV. It should be kept in mind that plasma cholinesterase production, synthesized in the liver, is reduced with age. Use of a stylet in the endotracheal tube is debatable for older patients. Weakening of the posterior membranous portion of the trachea increases the possibility of tracheal trauma.

Maintenance of general anesthesia may be accomplished using nitrous oxide in a concentration of 50-60%, with oxygen. This is an ideal agent for the elderly patient because it provides good analgesia with negligible toxic effects. Deeper anesthesia is attained using supplemental intermittent doses of intravenous agents, such as fentanyl or meperi-

dine, or various inhalational agents. Inhalational agents most commonly used today are halothane, enflurane, and isoflurane. A degree of cardiovascular depression may occur with any of these agents. Regarding the newest member of this trio, isoflurane (Forane®) has been compared to halothane in terms of cardiovascular effects in the older patient. Both agents produced similar decreases in arterial pressure, cardiac output, and stroke volume with isoflurane found to be no more depressant than halothane.

Muscle relaxation may be attained using the agent preferred by the anesthetist. It must be remembered that skeletal muscle mass in the elderly is decreased in size and vigor. An overdose may be achieved if calculation of dose using the same criteria as for younger patients is done. There is also an age-associated increase in arrhythmias following neostigmine administration for reversal of nondepolarizing muscle relaxants.

Dissociative anesthesia via administration of ketamine has proven useful in some instances in geriatric patients. While hallucinations following emergence from dissociative anesthesia have occurred in the general population, this has a low incidence in the geriatric patient. As a sole agent, ketamine is most often used only for burn debridements and dressing changes. An induction dose of 25-75 mg intravenously may be an excellent alternative to the patient in borderline shock who requires emergency surgery. Ketamine is contraindicated for patients with hypertension or increased intracranial pressure.

Postoperative considerations

Following cessation of anesthesia, 100% oxygen must be administered via mask or endotracheal tube for a period of not less than five minutes. Before he leaves the operating room, the patient's respiratory status is evaluated by measuring tidal volume, minute volume, and inspiratory force. If respiratory depression is evident due to either agents administered or inadequate reversal of muscle relaxants, mechanical ventilation may be necessary in the recovery area.

If mechanical ventilation is necessary, serial blood gas determinations should be performed. These values should correlate well with preoperative values prior to extubation. Postoperative hypotension, due to inadequate fluid or blood replacement, should also be considered and treated. Respiratory and cardiovascular distress in the early postoperative period may be a result of a tension pneumothorax due to a ruptured emphysematous bulla. Later, respiratory distress may be a result of
atelectasis or pulmonary embolism caused by ineffective coughing or immobility.

Conclusion

Statistics have made clear the fact that an increasing number of elderly patients will be treated surgically in the future. This fact requires that today's anesthetist be prepared for this increase with a working knowledge of the physiologic changes associated with age and their optimal anesthetic care. This article is not meant to suffice as an all-inclusive report of anesthetic considerations in the elderly. Rather, it presents a general overview of those considerations most predominant. Further research into the study of geriatric anesthesia is considered both wise and timely.

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