THE MEDICAL CLINICS OF NORTH AMERICA

Med Clin N Am 87 (2003) 273–289

Perioperative care for the elderly patient

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> In 1927, as a young Professor of Surgery at Tulane Medical School, I taught and practiced that an elective operation for inguinal hernia in a patient older than 50 years was not justified. Alton Ochsner, MD

The perioperative management of the elderly has undergone major changes over the past eight decades. This has become increasingly the case with the dramatic shift in the population toward the elderly with the aging of the baby boom of the 1950s. The age group 65 years and older is the fastest growing segment in the United States, expected to comprise 20% of the population by 2025.

Changes are increasingly apparent as the population ages and older patients are considered for surgery with greater frequency. In England, for example, surgical admissions for the elderly now outnumber nonsurgical admissions. One half of individuals over the age of 65 will undergo major surgery during their lifetime, with most procedures in patients in their sixth decade and beyond.

The diseases for which surgery is performed, the surgical procedures performed, and the goals of the intervention also are changing with the aging of the surgical population. There is a pronounced shift from minor surgical procedures, trauma surgery, and surgery for nonmalignant disease to surgery for ocular, orthopedic, coronary artery, peripheral vascular, and neoplastic (especially pulmonary, colorectal, and genitourinary) diseases.

Despite the rapidly increasing need for surgery in the elderly, a scarcity of literature exists studying the perioperative care of the elderly. Perioperative care becomes more complicated with age. The initial presentation of a surgical problem is more likely to be of greater severity. In the extreme, the presentation requires emergent surgery more frequently in the elderly (eg,

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PII: S0025-7125(02)00155-4

it is much more common to see intestinal obstruction as the surgical justification for surgery in colorectal cancer in the elderly compared with a younger population). Disease at presentation is more advanced, whether malignant (cervical or colorectal cancer); vascular (coronary artery or peripheral artery disease); or other (degenerative disease of the spine). As a result of these and other factors, the goal of the surgery is more often palliative than curative.

Elderly patients for surgery are more likely to have surgery canceled for comorbid conditions after admission than a younger cohort. Hospitalizations for surgery are prolonged on average in the aged, independent of the presence of comorbid conditions. Evaluating the perioperative risk of these patients is very important.

The study of perioperative assessment and care of the elderly patient has lagged behind the science of perioperative management in general. Much of the art of perioperative care in the elderly is extrapolated from literature on younger populations. The literature in perioperative care is primarily descriptive as opposed to outcome derived.

The individual patient conditions' contribution to surgical risk is related to a combination of physiologic changes associated with underlying diseases, combined to a lesser degree with age-related physiologic changes. Research over the past several decades has clarified perioperative risk factors, showing that age by itself is at most a minor risk factor for perioperative complication [1,2]. As one author has noted, "Increased risk, when present, is attributable to both normal aging, because of decreased physiologic reserve, and pre-existing disease or pathologic changes not uniformly seen in all geriatric patients." The impact of age on surgical risk comes through a physiologic decrease in vital organ function, leading to a decreased ability to respond to perioperative stress. Functional status changes associated with aging seem to be more important risk factors in the elderly.

Demographics

Surgery is performed more frequently in the elderly (136 procedures per 100,000 aged 40 to 64 years and 190 per 100,000 over 65). One third of all surgeries in the United States are performed in patients 65 years and older. Age is less of a risk factor than several age-associated changes, including increased prevalence of chronic diseases; increased need for emergent surgery (eg, patients over the age of 65 are more than twice as likely to present for emergent surgery as younger patients, 37% versus 17%); and overall alterations in functional status in major organs. All of these factors combined lead to a sicker population presenting for surgery (eg, approximately 80% of patients over the age of 89 present with American Society of Anesthesiology class III) as evidenced by the identical mortality rates by American Society of Anesthesiology score independent of age (Table 1).

Table 1
Age versus physical status

	% Mortality				
Age	I	II	III	IV	V
1–30	6	8	22	28	36
31–50	2	11	25	37	25
51–70	1	8	29	39	23
>70	0	5	25	45	25

Finally, the incidence of chronic diseases and disabilities is increased in the elderly. On average, a patient over the age of 74 has three disabilities or diseases. In patients over the age of 65, 20% present with no problems and 30% have more than three problems. Complicating this is the increased difficulty in the recognition of diseases in the elderly. One example is the assessment of cardiac disease that is complicated by the increased presence of silent ischemia, underreporting of symptoms, and decreased physical activity, among many factors obscuring the diagnosis. The physician must have heightened awareness of atypical presentations of disease (typical angina less commonly, atypical presentations become more common). Cardiovascular functional assessment is made more difficult as patients decrease activity. Even in nursing home–bound, inactive patients, however, risk in selected populations can be relatively low (2.3%). The pattern of atypical presentations is seen in many illnesses, both cardiac and those involving other organ systems.

Impact of age-related physiologic and anatomic changes

Age-related changes lead to altered organ function. Although allowing normal day-to-day functioning, the impact of changes leads to decreased functional reserve of the individual. The individual's response to stress is compromised. Several changes are of critical importance when discussing perioperative risk: cardiac, pulmonary, renal, and changes leading to altered pharmacology and pharmacokinetics.

Cardiac

The heart undergoes many changes. There is no inevitable decrement in rest cardiac function, in the absence of coexisting heart disease. However, cardiac output, in response to stressors is blunted. In part this is caused by a decreased responsiveness to catecholamines. Older patients have increased ectopy in the absence of cardiac dysfunction.

Accompanying these physiologic changes are anatomic ones. There is an increase in ventricular mass (left ventricular hypertrophy); increased fibrosis within the myocardium and conduction system; and calcification of the

aortic and mitral valve skeletons. Clinically this is manifested as congestive heart failure from diastolic dysfunction. The hypertrophied myocardium responds to decreased filling with decreased exercise tolerance; cough (especially dependent); dyspnea; and fatigue. Late in the process, the obliteration of the left ventricular cavity, with low filling volumes, may lead to symptoms of low cardiac output.

Pulmonary

The changes in the respiratory system include changes in the chest wall, respiratory musculature, and the lung parenchyma. The thorax becomes stiffer with age, increasing the work of breathing and decreasing lung volumes. The strength and endurance of the musculature decrease with age. Parenchymal changes include decreased ciliary function and number and interstitial stiffening. The clinical effect of these changes is a gradual decrease in Po_2, increased dead space, and decreased expiratory volume and flow rate. The net result is an overall decline in pulmonary function. More important is the narrowing of the gap between tidal volume and closing volume, leading to increased risk of postoperative respiratory complications.

Renal

Renal changes include a decrease in numbers of functional units, and decreased functional status of the units (decreased blood flow and decreased glomerular filtration). These changes are primarily manifested in response to rapid volume changes rather than as baseline dysfunction. In fact, the traditional methods of estimating renal function (serum creatinine and creatinine clearance) typically overestimate actual values because of the decreased muscle mass. In the elderly, a more accurate estimate of renal function comes from the Crockroft-Gault equation (females, multiply by 0.85):

$$\frac{(140\text{-age}) \times \text{weight(kg)}}{72 \times \text{serum creatinine}}$$

Nutritional

An increasingly important factor is nutritional status. Several studies have documented the negative effect of poor nutritional status on surgical outcome and complications. Other studies have documented an associated decrease in perioperative complications (although not in overall outcome) in patients undergoing oncologic procedures given nutritional supplementation for at least 1 week preoperatively.

Laboratory abnormalities

The prevalence of abnormal test results varies according to the test. Abnormalities of common laboratory tests occur in 0.5% to 15% in an

asymptomatic, low-risk geriatric population. As in younger populations, the abnormalities found in this manner (asymptomatic polychemistry profile testing) do not correlate with a higher morbidity or mortality.

Altered pharmacokinetics

Changes occur in both the uptake and metabolic handling of drugs, which lead to an increased incidence of complications and toxicity. Included are changes in altered gastrointestinal motility and blood flow; renal function; decreased hepatic function and blood flow; decrease in serum drug-binding proteins; and altered volume of distribution (caused by decreased lean body mass and reciprocal increase in total body fat). Finally, as noted in cardiac changes, there may an altered receptor response to drugs.

Predicting and preventing postoperative complications

Delirium

Delirium is a clinical syndrome in which there is an acute disruption of attention and cognition. Up to 20% of elderly surgical patients experience delirium as a postoperative complication. Orthopedic surgery patients, especially those with hip fracture, may have an incidence of delirium of 28% to 60% [3,4].

The development of postoperative delirium has been associated with increased morbidity and mortality. Marcantonio et al [3] found that the development of delirium was associated with increased risk of major complications (myocardial infarction, pulmonary edema, pneumonia, respiratory failure, and so forth). In their study (as in many others) delirium was associated with an increased risk of death, increased length of stay, and an increased rate of discharge to long-term care facilities. Additionally, patients with hip fracture were found to have poor functional recovery at 1 month if delirium developed in the postoperative setting [5].

Although all elderly patients may be at some risk for the development of postoperative delirium, it may be possible to identify patients at highest risk preoperatively and focus interventions on this group. Marcantonio et al [3] developed a clinical prediction rule for postoperative delirium based on preoperative risk factors, including age, history of alcohol abuse, pre-existing cognitive dysfunction, pre-existing physical impairment, type of surgery, and the presence of metabolic abnormalities. Patients with three or more of these risk factors had a 50% risk of postoperative delirium.

Evaluation of the elderly patient who develops delirium requires consideration of preoperative, intraoperative, and postoperative factors [4]. Preoperative factors include pre-existing dementia, polypharmacy, drug or alcohol use/abuse, metabolic derangements, and depression. All efforts should be made to correct metabolic abnormalities before surgery and anesthesia.

Medication lists should be reviewed carefully and any unnecessary medications stopped. Patients should be questioned carefully about the use of over-the-counter drugs and supplements.

Intraoperative factors that have been associated with postoperative delirium include the type of surgery and the anesthetic drugs used [4]. Among the highest-risk surgical procedures are cardiac surgery; hip fracture surgery (especially femoral neck fractures); and ophthalmologic surgery [5,6]. Anticholinergic agents have been associated with postoperative delirium. Barbiturates and benzodiazepines may also play a role. There seems, however, to be no increased risk when general anesthesia is compared with regional anesthesia [5,7]. Intraoperative hypotension or hypoxemia may also be risk factors for postoperative delirium.

Postoperative causes of delirium may be similar to preoperative causes. Postoperative hypoxia and hypotension may contribute to delirium. Pain and pain medications, particularly meperidine, may also play a role. Other psychoactive agents (eg, benzodiazepines and sedatives) may be used more frequently postoperatively [8]. Sepsis and metabolic abnormalities need to be considered in this setting, as does myocardial infarction. Withdrawal from alcohol or drugs should be suspected in any patient with a preoperative history of use. Environmental changes and altered sensory input (decreased visual acuity because glasses are not available and decreased auditory acuity because hearing aids are not available) can contribute to the development of delirium, especially in patients with pre-existing cognitive impairment.

There are many etiologic factors to consider in a patient with postoperative delirium. There are considerable data that help identify patients at risk [3,6,7]. Once these high-risk patients have been identified, one must be able to intervene to prevent the onset of delirium. Several studies have looked at measures designed to reduce the incidence of postoperative delirium [9–12,20]. Most studies have focused on comprehensive, multidisciplinary geriatric assessment as a key component of reducing the incidence of delirium. This intervention must occur before the onset of delirium. Once delirium developed, the interventions were not as effective, although the severity may have been reduced [9]. Careful preoperative assessment, ongoing postoperative assessment, cautious use of medications, correction of metabolic abnormalities, and attention to environmental factors remain the most effective ways to prevent postoperative delirium. Comprehensive geriatric assessment and follow-up seems to be effective because it focuses on minimizing these risk factors.

Postoperative confusion can be associated with significant consequences for the patient, the nursing staff, and the family. Once it has developed, etiologic factors should be identified quickly and corrected if possible. Any drugs that may be contributing should be stopped or decreased in dosage. Haloperidol or risperidone can be used to help manage behavior that may place the patient at risk for self-harm. Benzodiazepines should be used in patients suspected of having delirium tremens. Thiamine should also be

given to these patients. Physical restraints may increase the risk of injury and should be avoided if possible. Patients need frequent orientation to time, place, and circumstances. Clocks and calendars may help with orientation. Lighting in the room should mimic day-night cycles. Glasses and hearing aids should be used if needed. Patients should be out of bed as soon as possible. These simple measures may help shorten the course and improve the outcome of postoperative delirium.

Immobility

Immobility can be devastating to an elderly patient who has recently undergone surgery. Multiple organ systems can be affected by immobility, including the skin, the cardiovascular system, the lungs, the musculoskeletal system, and the gastrointestinal and genitourinary tracts. In addition, there may be significant psychosocial consequences of prolonged bed rest. The elderly, however, may be more likely to be at bed rest postoperatively because of underlying frailty and debility; increased frequency of musculoskeletal problems (arthritis and muscle weakness); and increased caregiver time and expense required to encourage mobility.

Pressure ulcers are a significant source of morbidity and mortality for postoperative patients. The elderly are particularly at risk. Hip fracture patients have a high incidence of pressure ulcers [13], and these ulcers are associated with an increased mortality. Although there are many studies of pressure ulcer development in hospitalized patients, there are surprisingly little data looking at the perioperative setting. Age, length of surgery, nutritional status, and type of surgery are all potential risk factors. In addition, emergency surgery and critical illness may increase risk. Shorter surgeries may actually increase the risk of pressure ulcers because careful pressure relief may be neglected [14].

Elderly patients, especially those with hip fractures, are at increased risk for osteoporosis. Bed rest increases that risk substantially. Zerwekh et al [15] studied the effects of bed rest on bone mineral metabolism. They found a significant increase in bone resorption by both biopsy and biochemical markers. There was no change in the rate of new bone formation, which led to a significant decrease in bone mineral density, especially at the greater trochanter. This could contribute to risk of future fractures and impair fracture healing if not corrected.

Pulmonary risks associated with immobility include atelectasis, increased risk of aspiration and pneumonia, and increased risk of venous thrombosis and pulmonary embolism. Early ambulation is the most effective technique for reducing the risk of postoperative pulmonary complications. Cardiovascular deconditioning also occurs. This can be associated with a decrease in cardiac output, decreased stroke volume, or orthostatic hypotension. Cardiac atrophy is associated with a reduction in left ventricular size and distensibility, which alters the Starling mechanism [16].

Immobility also has a number of metabolic effects, including negative nitrogen balance, decreased tissue sensitivity to insulin, and altered calcium metabolism [17]. Oral intake may be impaired by the anorexia induced by bed rest [16]. Confinement to bed or chair can also lead to sensory deprivation, loneliness, and depression, and may increase the risk of postoperative delirium. Immobility may also be associated with constipation and fecal impaction. This can create a vicious cycle of decreased oral intake and increased malnutrition. Mobilization can decrease the risk of constipation, impaction, and ileus.

All of these potential complications can lead to only one conclusion: despite many factors that may impair mobility in elderly postoperative patients, these patients need an aggressive mobilization strategy that is multidisciplinary in nature. Physical and occupational therapists, nurses, physicians, family members, and most especially the patients themselves must participate in the mobilization program. Rehabilitation programs must start early and continue as long as is necessary for maximal functional recovery.

Malnutrition

In industrialized countries, the elderly are perhaps at most risk of being malnourished. Many elderly patients live on limited incomes. Many more have decreased access to transportation. These factors may limit availability of nutritionally valuable foods. Appetite is often decreased because of medications, alterations in taste and smell, coexisting medical illness, and decreased activity. Little is known about the requirements for vitamins, minerals, and trace elements in older people. Surgical disease (eg, gallbladder disease or abdominal ischemia) and preoperative testing may further increase the risk of preoperative malnutrition.

Serum albumin can be used as a marker for malnutrition. Gibbs et al [18] showed that serum albumin levels were excellent predictors of 30-day postoperative mortality. This was true even for patients who were otherwise considered to be low risk. Malnutrition must be identified preoperatively. Elderly patients with preoperative malnutrition may develop protein-calorie malnutrition from the stress of surgery. Negative nitrogen balance depletes visceral protein stores. This leads to loss of muscle mass, which impedes efforts at postoperative rehabilitation and ambulation. This vicious cycle leads to increased risk of postoperative pulmonary complications and other consequences of immobility. Impaired immune response may lead to difficulty with wound healing.

Prevention of malnutrition should begin preoperatively with identification of patients at highest risk. Nutritional status should be monitored and addressed from the first postoperative day. Elderly patients, especially those with pre-existing malnutrition, should not be allowed to ''fall behind'' nutritionally. Voluntary food intake should be monitored and nutritional supplements introduced promptly in patients with inadequate intake. Although

nasogastric feeding is an attractive option, many patients tolerate it poorly. Oral supplementation, if monitored carefully, is probably adequate [16]. Parenteral feeding should be used only as a last resort for patients with altered gastrointestinal tract function. Elderly patients are particularly vulnerable to complications of parenteral feeding.

Infections

Postoperative infections are an important source of morbidity and mortality in elderly patients. The most common sites of postoperative infection are urinary tract infection, surgical site infection, and pneumonia [17]. Elderly patients may have diminished immune function, which predisposes them to infection, although there is little known about specific decreases in immunologic competence [17].

Urinary tract infection is almost always caused by prolonged catheterization. Elderly patients are at increased risk to be catheterized because of medication side effects; pre-existing incontinence; and decreased mobility, which impedes toileting. Symptoms of urinary tract infection in the elderly may be subtle. For example, postoperative confusion may be the first and only sign of a urinary tract infection. Avoidance of catheterization if possible and early removal of the catheter are the most important steps in preventing urinary tract infections postoperatively.

Pneumonia is a leading cause of postoperative mortality in elderly patients. Vigorous pulmonary toilet and aggressive early mobilization are needed to decrease the risk of this complication. Additional risk is conferred by nasogastric tubes, dementia, and immobility. Malnutrition and impaired immune function may increase the mortality associated with postoperative pneumonia.

Continence

Incontinence is never a normal consequence of aging and should not be an accepted complication of surgery. Every effort should be expended to maintain continence perioperatively. The development of incontinence may prolong the length of stay or may result in an elderly patient entering a nursing home. Indwelling catheters should be removed as soon as possible postoperatively (or avoided altogether, if possible). Urinary retention can be managed with intermittent catheterization [19]. Factors that contribute to incontinence and urinary retention should be eliminated. Immobility, anticholinergic medications, intravenous fluids, delirium, constipation, and urinary tract infection may all be contributing factors. Systematic toileting and prompt responses to requests help maintain continence.

Outcomes of surgery in the elderly

As the population ages, we are faced with increasingly difficult and complex decisions about health care in elderly patients. Until recently, many

patients were denied necessary surgical procedures (both elective and emergent) solely on the basis of chronologic age. Over the last two decades, significant insights have been gained into the risks faced by those over 65 who undergo surgery and anesthesia. It has been learned, first of all, that many of these patients can safely be treated surgically. At times, one needs to elucidate carefully the goals of the surgical procedure proposed. When discussing risks and benefits, one must consider not only the risks of the surgery but also the risks of no surgery [21].

Emergency surgery has clearly been associated with an increased risk of postoperative morbidity and mortality in all age groups, but particularly in the elderly [21]. Patients should be advised to have surgical disease managed electively to avoid the risk of complications that might require emergency surgery.

Why are elderly patients at such increased risk? Is it age alone or are other issues at play? Comorbidities, such as diabetes, hypertension, heart disease, and arthritis, can contribute substantially to the risk of poor postoperative outcomes. Indeed, many studies [21–23] have suggested that other medical problems, which are more frequent with age, are responsible for the increase in perioperative complications seen in older patients. Polanczyk et al [24] recently demonstrated that age in and of itself was associated with an increase in perioperative complications and longer length of stay. The encouraging finding of this study was that overall perioperative mortality was quite low, even in patients over the age of 80. Magnuson et al [25] studied laparoscopic cholecystectomy in elderly patients. Their findings suggest that laparoscopic cholecystectomy for uncomplicated gallbladder disease could offer the same benefits to older patients that have become apparent in younger patients: decreased pain, shorter hospital stays, and earlier return of preoperative functional status. Because return to baseline functional status is particularly important in the elderly, laparoscopic cholecystectomy might offer even more benefit to this group. Elderly patients, however, were more likely to present with complicated gallbladder disease (acute cholecystitis, gallstone pancreatitis, and common bile duct stones), which is more likely to require conversion to open cholecystectomy. Unfortunately, many elderly patients with known gallstone disease were not offered surgical therapy until complications developed. This delay resulted not only in increased conversion to open procedures but also in increased perioperative morbidity and prolonged length of stay. Elective surgical therapy when possible may be the best way to improve perioperative outcomes in the elderly.

Careful preoperative assessment and optimization of medical problems should allow elderly patients to take advantage of minimally invasive surgery with significantly less risk [26,27]. Cardiac and pulmonary complications are the most frequent causes of perioperative morbidity and mortality in the elderly. Particular attention should be directed toward minimizing these complications. A thorough history and physical examination is the cornerstone of preoperative risk assessment. Preoperative functional status is

particularly important in the elderly. Physically fit, active patients, who can perform at least four metabolic equivalents (METS) of work, have decreased risk of perioperative complications. Unfortunately, many elderly patients have limitations on functional status because of musculoskeletal problems (eg, osteoarthritis). Cardiopulmonary fitness is more difficult to assess in this group.

Elderly patients tend to have decreased cardiovascular reserve, although the degree of decline varies from individual to individual. The prevalence of coronary heart disease increases with age, as does the presence of other types of heart problems, such as valvular disease, congestive heart failure, and rhythm disturbances. Decreased reserve and increased disease contribute to an overall increased risk of perioperative cardiac complications in the elderly [24]. The optimal strategy for cardiac risk stratification in this age group is unclear. The American Heart Association and American College of Cardiology guideline cites age as a minor clinical predictor of perioperative risk. This guideline also focuses on functional status as a significant factor in preoperative risk stratification. Because this may be more difficult to ascertain in elderly patients, optimal preoperative testing is less clear. One may need to resort to nonexercise stress testing (eg, stress echocardiography) for moderate- and high-risk surgical procedures when functional capacity is unclear. Although one generally can identify higher-risk patients, strategies for risk reduction remain unclear. β-Adrenergic blockers seem to offer the most promise for decreasing perioperative cardiac risk. Whether other modalities are beneficial remains to be seen. Timing, dosage, and duration of therapy remain unknown. Elderly patients should be considered for β-blocker therapy unless a contraindication exists.

Postoperative pulmonary complications can pose a significant threat to elderly patients. Age-related decline in pulmonary reserve and changes in pulmonary function caused by surgery and anesthesia increase risk of postoperative pulmonary complications. Abdominal and thoracic surgical procedures cause a decrease in vital capacity, functional residual capacity, respiratory muscle dysfunction and changes in chest wall mechanics. All of these changes increase the likelihood of early airway closure and atelectasis, which can lead to a ventilation-perfusion mismatch. The presence of pulmonary disease further increases the risk of postoperative pulmonary complications. Neurologic problems, such as stroke and dementia, increase the risk of aspiration. Preoperative pulmonary function tests, however, are rarely useful in predicting risk of postoperative pulmonary complications. As with cardiac risk, functional status is a more important predictor of postoperative pulmonary complications.

Prevention is the key to minimizing the risk of postoperative pulmonary complications. Patients and their families should be educated preoperatively about the importance of deep breathing, coughing, incentive spirometry, and early postoperative ambulation. Smoking cessation should be encouraged, although optimal timing is unclear [28]. Patients with chronic obstructive pulmonary disease should be evaluated in a timely fashion to ensure

that there is no evidence of acute exacerbation. Adequate postoperative analgesia should help with deep breathing, coughing, and early ambulation. Care must be taken, however, to avoid oversedation.

Polypharmacy and alterations in drug metabolism may lead to an increased risk of perioperative complications. Multiple medications may precipitate or exacerbate postoperative delirium. Diuretic use can cause electrolyte disturbances, which in turn may increase the risk of postoperative delirium and cardiac arrhythmias. Drugs with anticholinergic effects may cause delirium or may precipitate urinary retention and constipation.

Alterations in drug metabolism can occur at many sites. Age-related changes in renal and hepatic function all affect the absorption and metabolism of drugs. Older patients may have decreased absorption of medications because of decreased blood flow to the gastrointestinal tract and of alterations with gastric acidity. Gastric motility may be decreased, especially in patients with diabetes.

Kidney function is subject to the same age-related decline as other organ systems. Serum creatinine may not rise, even with significant renal dysfunction, because of decreased muscle mass. Comorbidities, such as diabetes, hypertension, vascular disease, and congestive heart failure, may further impair renal function. Renal dose adjustment should be made in elderly patients, especially if the glomerular filtration rate is less than 80 mL/min. Nephrotoxic drugs should be avoided.

Hepatic blood flow is responsible for drug delivery to the liver. Hepatic mass determines the availability of hepatic enzymes for drug metabolism. Both of these functions may be decreased with age. The metabolism and clearance of many drugs used perioperatively are affected by this decrease in hepatic function. Any drugs that are hepatically metabolized should be used with caution in the elderly. This is particularly true of benzodiazepines, which can have a prolonged half-life in this group of patients. Additionally, elderly patients can have a paradoxical response to benzodiazepines.

Volume of distribution is also substantially altered in the elderly. Many older patients have decreased total body water and increased total body fat, with decrease in lean body mass. This can lead to an increased volume of distribution of fat-soluble drugs and a decreased volume of distribution of water-soluble drugs [17]. Serum albumin may be decreased and protein binding may be altered.

Anticipation and avoidance are the key to minimizing the problems associated with polypharmacy. Medication lists should be reviewed carefully preoperatively. Patients should be questioned about the use of alcohol and over-the-counter medications and supplements. Medication regimens should be simplified as much as possible preoperatively. Any unnecessary or duplicated medicines should be discontinued. Where possible, drug levels should be checked preoperatively to avoid toxicity and ensure therapeutic efficacy. Patients and their families should be given clear written and verbal instructions about preoperative changes in their medication regimens.

The do-not-resuscitate status in the perioperative setting

More and more, elderly patients are being encouraged to make decisions about end-of-life care. As older patients become sicker, they need to think seriously about which life-prolonging measures they would consider appropriate and which they would like to avoid as noxious or overly burdensome [29]. Many elderly patients execute do-not-resuscitate (DNR) orders because of a combination of comorbidities rather than a single terminal illness. These patients should not be denied surgical procedures simply because of the existence of a DNR order.

Institutional policies differ with respect to DNR policies in the operating room [31]. Some institutions require that DNR orders be suspended automatically during anesthesia. The assumption underlying this policy is that anesthesia is an iatrogenic situation and a cardiac arrest in this situation is potentially reversible. Proponents of this viewpoint argue that this is fundamentally different from allowing an underlying disease to "take its course." This is an important consideration in this group of patients, who are more likely to undergo surgery to relieve pain or improve quality of life.

Patients with DNR orders who suffered perioperative cardiopulmonary arrest were unlikely to survive to hospital discharge. There seemed to be no benefit in attempting to resuscitate a patient with a DNR order who suffered an arrest [31,32].

Are patients being denied surgical procedures because of the presence of a DNR order? The SUPPORT investigators [30] found that this was generally not the case, once other variables were adjusted for (estimate of 2-month survival, diagnosis, age, and severity of illness). What happens to the DNR order perioperatively? Clemency and Thompson [33] studied the attitudes of internists, anesthesiologists, and surgeons. Most anesthesiologists assumed that the DNR order was suspended in the perioperative period. Internists and surgeons underestimated this assumption. All three groups believed that the internist, surgeon, anesthesiologist, and patient should share the responsibility for defining the DNR status perioperatively. They also believed that this issue should not be decided by hospital policy.

Although there are little data available, it seems that patients with preexisting DNR orders who undergo surgery do have a slightly increased risk of cardiopulmonary arrest intraoperatively or postoperatively [7].

Walker [33] has likened the DNR order to the Jehovah witness's right to refuse blood transfusion. He notes that this refusal of treatment should not deny the patient the right to a surgical procedure. He advocates a more flexible approach to this problem. Patients and their physicians (surgeons, internists, and anesthesiologists) should enter into a dialogue about how the DNR order will be interpreted in the perioperative period. All risks and benefits should be discussed (and carefully documented). The patient's preference, however, should determine the final outcome of this decision-making process.

Role of the generalist in the perioperative management of the elderly patient

As reviewed, the generalist has a vital role in the perioperative care of the elderly patient. Many functions are similar to those for all patients:

1. Assessing risk for perioperative complications:
   Specific disease-related risk
   Physiologic changes associated with aging
2. Developing a diagnostic or therapeutic plan for optimizing the patient's physical status and minimizing risk
3. Developing a plan for monitoring for perioperative complications in patients at increased risk
4. Examining for the presence and status of other illnesses not necessarily related to perioperative risk
5. Developing a therapeutic plan for the perioperative management of these illnesses
6. Defining the risks and benefits for the individual patient, which may be significantly altered in the elderly as already discussed (relief of suffering or improvement in functioning and quality of life become more overriding issues rather than simply prolongation of life)
7. Becoming intimately involved as part of the team that follows-up maintaining patient functioning postoperatively and following discharge from the hospital

Summary

As the population survives longer, surgery has become a much more common consideration. Preoperative management of these patients requires a working knowledge of changes associated with aging and the physiology of surgery and anesthesia. Using this information, patients can be clinically evaluated effectively and plans made for their perioperative care to minimize complications.

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