A Geriatric Anesthesiology Curriculum

A **Geriatric Anesthesiology Curriculum** was created through the collaborative efforts of the members of the American Society of Anesthesiologists Committee on Geriatric Anesthesia and the Society for the Advancement of Geriatric Anesthesiology (SAGA). It was developed in cooperation with the American Geriatrics Society (AGS) and supported through the AGS/John A. Hartford Foundation of New York City Project: *Increasing Geriatrics Expertise in Surgical and Related Medical Specialties*.

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*Created and approved by the American Society of Anesthesiologists (ASA) Committee on Geriatric Anesthesia: October 14th 2007*
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COMPLETE LIST OF REFERENCES

Reference Books: These textbooks provide comprehensive up to date information on Geriatric Anesthesiology.


ASA Syllabus
A Geriatric Anesthesiology Curriculum

The population is rapidly aging – and the oldest old (> 85 years) in our society represent the most rapidly growing section in the population. Thirty five percent of surgeries in the USA are performed on patients over the age of 65 years – totaling more than 16 million operations annually. For anesthesiologists this means that an understanding of the consequences of aging will be required to safely administer anesthesia to this segment of the population.

Aging results in a steady decline in functional reserve, and each organ system is affected to a variable degree by ‘normal’ aging. Accordingly, there are predictable changes that may affect an older person’s ability to undergo surgery and anesthesia. The presence of numerous comorbid conditions in elderly patients unpredictably alter the aged patient’s ability to respond to stress and illness. Thus, the challenge of administering an anesthetic to elders lies in gauging the individual’s functional or physiological status vs. the stated chronological age.

The goal of this curriculum is to provide a comprehensive list of topics for the Consultant in Geriatric Anesthesiology. Each section contains one or more broad goal accompanied by corresponding objectives. A select bibliography is included, with a brief statement of relevance for each article. It is understood that the depth of knowledge and expertise will vary depending on the interest and practice of the practitioner.

BACKGROUND

1. Definitions and Demographics

Goals:
1. To understand common terms of senescence and aging.
2. To understand demographic trends in surgery and aging.
3. To understand evolving concepts of outcomes in geriatrics.

Objectives:
1. Define normative aging, including the following terms: Old; Old Old, Elderly and the Oldest Old. Definitions should include comments on heterogeneity, variability, and decreased organ system functional reserve in aging.
2. Describe characteristics associated with ‘frailty’
3. Define the Medicare population.
4. Comment briefly on the role of a geriatrician and the surgical patient.
5. List primary surgical procedures in the elderly.
6. Describe the key factors affecting surgical survival in elderly patients, for example, surgical type and emergency status.
References:

   A case series of 795 surgical patients 90 years of age and older and their long-term outcomes.

   In patients undergoing CABG, age 80 years or older is an independent predictor of increased resource utilization, postoperative morbidity, and mortality.

   This chapter gives a comprehensive discussion of the demographics of aging in America.

   A discussion of the role that geriatrics will play in the ‘graying’ of America.

   A good review of frailty.

   Operative mortality decreases with increasing hospital volume for several cancer resections. However, volume may be most important in patients who are older.

   This paper provides mortality rates for many types of procedures.

   This study looks at the importance of intraoperative versus preoperative risk factors in predicting adverse postoperative events in geriatric patients.

10. Hamel MB, Henderson WG, Khuri SF, Daley J. Surgical outcomes for patients aged 80 and older: morbidity and mortality from major noncardiac surgery. J Am Geriatr Soc 2005;53:424-9. *This is a large prospective study looking at morbidity and mortality in old and very old veterans’ postoperatively. They found that postoperative mortality at 30 days was greater in very old (over 80 years) vs. younger old patients; 8% vs. 3%. However for minor operations such as hernia repair or TURP the mortality rate was low (<2%) even in the oldest patients. Postoperative complications in the oldest patients was associated with a higher 30 day mortality.*

### 2. Knowledge of Health Care/Economical Issues Related to Aged Patients

**Goals:**
1. To understand the basic distinction between Medicare vs. Medicaid.
2. To understand types of care facilities and the level of care provided in the facilities.
3. To understand the cost and importance of prevention of perioperative complications.

**Objectives:**
1. Define Medicare Part A, B, D.
2. Define Pay for Performance.
3. Describe distinguishing features of different types of post-hospitalization housing available for the elderly patient (e.g. skilled nursing facilities, nursing homes etc.)

**References:**
1. Geriatrics Review Syllabus 6th Edition; Chapters 1 & 5. [www.geriatricsreviewsyllabus.org](http://www.geriatricsreviewsyllabus.org) *These chapters provide comprehensive discussions on the demographics of aging in America (Ch 1) and on the financing of health care including Medicare for the elderly in America (Ch 5).*


3. [www.medicare.gov](http://www.medicare.gov)
The federal government’s Medicare website.

A perspective article which summarizes the advantages and disadvantages of pay for performance programs.

An excellent comprehensive textbook on all aspects of Geriatrics.

3. Knowledge of Ethical Considerations in Aged Patients

Goals:
1. Understanding the issues of consent.
2. Understand the distinction between advanced directives, DNR, health care proxy, and living wills
3. Understand concept of futility.

Objectives
1. Explain how to decide if a patient has the capacity to consent.
2. Explain who is able to consent if the patient is not able.
3. Explain the local rules regarding advanced directives.
4. How is DNR defined in your institution?
5. Explain mechanism and systems for withdrawal of care.

References:
This report reviews our current understanding of DNR in the OR. In addition it provides practical recommendations for dealing with DNR orders in the OR and explores the concept of goal directed and procedure specific DNR orders.

This review provides an excellent case based overview of ethical dilemmas commonly encountered when caring for geriatric patients. The article reviews the determination of decision making capacity, explains the role of the Advance Directive and discusses DNR and withdrawal of care amongst other topics. The review provides an informative synopsis for those caring for elderly patients.
   This brief article raises some provocative issues surrounding informed consent and full disclosure of risk related to a surgery. It emphasizes the sometimes contradictory wishes of the patient and the physician.

   This brief report emphasizes the need to consider the patient’s medical condition and wishes versus their age when considering admission to the ICU. It provides a succinct review of available data on admission of elderly patients to the ICU.

**ORGAN SYSTEMS**

4. Understanding Anesthesia and the Impact of Aging on the Central and Peripheral Nervous Systems

**Goals:**
1. Understand normal age-related cognitive changes, stroke, Parkinson’s disease, Alzheimer’s disease, normal pressure hydrocephalus, cervical myelopathy, anesthesia and the impact of aging on neurotransmitter systems.
2. Understand normal age-related changes in the autonomic nervous system and its effect on anesthetic administration.
3. Understand normal physiologic changes in visual, auditory, and tactile systems.
4. Understand changes in peripheral nervous system function affecting pain transmission and proprioception.

**Objectives:**
1. To be able to describe the major transmitter systems involved in cognitive function and how age and anesthesia modify them.
2. To be able to perform a basic assessment of auditory, visual, tactile senses.
3. Describe changes in the peripheral nervous system influencing anesthetic choices.
4. Describe the impact of normal age-related cognitive changes and common central neurologic diseases on anesthesia assessment, consent, and evaluation.

**References**
Goal 1:

   This article reviews both normal and pathologic age-related changes in learning and memory. In addition, it describes some of the structural changes that occur in the normal and pathologic aged brain. In addition, it discusses normal compensations that occur in cognitively healthy aged individuals.

   This article reviews risk factors for the development of perioperative stroke and potential mechanisms and risk factors involved in its development.

   A review article that describes age-related neurodegenerative diseases with an emphasis on Parkinson’s disease. The article describes normal and neurodegenerative changes in the aged brain, issues related to drug therapy and administration during the perioperative period and anesthetic implications of neurodegenerative diseases and the pharmacologic agents used to treat them.

   This article reviews the age-related changes in brain dopamine levels and its association with normal and pathologic cognitive decline in aging.

   Impairment in cholinergic neural transmission has long been thought to be involved with both normal and aged related cognitive decline. This review highlights those findings as well as new evidence challenging the cholinergic hypothesis of normal age-related cognitive impairment.

This review describes the effects of aging on the glutamatergic neurotransmitter system.

Goal 2:
   A review of normal age-related changes in the sympathetic nervous system.

Goal 3:
   This article reviews the four most common causes of sight threatening diseases and how they alter quality of life in elders.

   This article reviews alterations in the somatosensory system that occur with age and potential mechanisms by which these changes occur.

Goal 4:
   A comprehensive review of the effects of aging on the peripheral nervous system and its ability to regenerate after injury are described in this review article.

   This article reviews normal age-related changes that occur in the peripheral and central nervous system that contribute to altered pain perception and response in the aged.

5. Understanding anesthesia and the impact of aging on the cardiovascular system

Goals:
1. Understand normal age-related changes in vascular structure and function that contribute to increases in systolic and pulse pressure and systolic hypertension.
2. Understand normal age-related changes in cardiac structure and function that contribute to left ventricular hypertrophy, diastolic dysfunction, and atrial arrhythmias.
3. Understand how normal age-related cardiovascular changes confer risk for overt cardiovascular diseases such as coronary artery disease, congestive heart failure, and atrial fibrillation.
4. Understand the impact of normal age-related cardiovascular changes on cardiovascular reserve capacity and understand methods to assess cardiovascular reserve capacity.

Objectives:

1. Describe how to preoperatively assess the aged cardiovascular system.
2. Describe the physiologic basis for blood pressure lability in the aged patient during general anesthesia and central regional anesthesia.
3. Define and differentiate between diastolic dysfunction and diastolic heart failure. Describe therapeutic management strategies for the aged patient with diastolic dysfunction, particularly volume management Goals.

References:

General Physiology and Pathophysiology of CV Aging

   This paper presents the normal age-associated changes in vasculature, e.g. increased intimal thickness, large artery dilation, and increased central arterial stiffness, that contribute to systolic hypertension and increases in pulse wave velocity and pulse pressure, ultimately conferring risk for overt clinical cardiovascular disease. Epidemiologic evidence for unsuccessful vascular aging and increased cardiovascular morbidity and mortality is included.
   This paper presents normal age associated changes in cardiac structure and function, e.g. left ventricular hypertrophy, diastolic dysfunction, impaired responses to β-receptor stimulation, and atrial fibrillation, conferring risk for future cardiovascular disease. The concept that age-related changes in cardiac structure/function (e.g. diastolic dysfunction) often remain
subclinical until the occurrence of an acute stress (e.g. surgery, infection), at which time overt cardiovascular disease (e.g. diastolic heart failure) in the elderly becomes apparent, is discussed.

This paper presents data from nonhuman primate and rodent studies of the various cellular and molecular mechanisms currently implicated in age-associated changes in vascular and cardiac aging. An understanding of these molecular mechanisms (e.g. vascular and cardiac remodeling) may provide hints to effective strategies that for preventing or attenuating the development of clinical disease of the aging heart and brain.

Excellent review summarizing the biochemical, enzymatic, and cellular evidence that implicate accelerated arterial aging as a risk factor for cardiovascular disease and adverse cardiovascular outcomes of aging.

This review provides an outstanding explanation of ventricular-arterial stiffening disease and its impact on cardiovascular reserve in the elderly. Specifically, age-related increases in arterial and ventricular stiffness may enhance pressure lability with fluid and postural shifts, salt loading, and exertion in the elderly. Also, reference to the human study of vascular-ventricular coupling across ages can be found in: J Am Coll Cardiol 1998:32:1221-7.

This paper reviews the clinical presentation, diagnosis, and management principles of the patient with diastolic heart failure.

**Anesthetic implications of CV changes of aging**

This is an outstanding review of the most relevant age-related cardiovascular changes that impact perioperative management in the elderly. Specific discussions include a) age-related declines in resting organ function that ultimately limit reserve capacity, b) age-related progression of chronic diseases that limit baseline function and accelerate functional reserve, and c) the increased intake of
medications and altered pharmacodynamics of advanced age that contribute to untoward reactions to anesthetics and surgical interventions in the elderly.

2. Rooke GA. Cardiovascular aging and anesthetic implications. J Cardiothorac Vasc Anesth 2003;17:512-23. This excellent review discusses how changes in cardiovascular aging contribute to hemodynamic instability, myocardial ischemia, heart failure, arrhythmias, and stroke. Suggestions for anesthetic management are also provided.

3. Groban L. Diastolic dysfunction in the older heart. J Cardiothorac Vasc Anesth 2005;19:228-36. This paper reviews the physiology of diastole, the pathophysiology of diastolic dysfunction and the clinical implications of diastolic dysfunction in the perioperative period.

4. Groban L, Butterworth J. Perioperative management of chronic heart failure. Anesth Analg 2006;103:557-75. This is a comprehensive review of current medical management of chronic heart failure, focusing on the results of large-scale, randomized clinical trials and published guidelines. Given the increased incidence of heart failure in the elderly, this review provides the anesthesiologist with the contemporary ‘best practices’ to make appropriate diagnostic and treatment choices and appropriate judgments about the need for cardiac consultations. Perioperative implications relating to each drug class (e.g. ACE-inhibitors) are also discussed.

6. Understanding Anesthesia and the Impact of Aging on the Upper Airway and Pulmonary System

Goals:
1. Understand the interaction between pulmonary age-related changes and disease.
2. Understand how to assess pulmonary reserve.

Objectives:
1. Describe age-related changes in pulmonary mechanics and pulmonary function tests.
2. Explain how to assess pulmonary reserve.
3. Explain how age-specific mechanisms contribute to hypoxia.
4. Explain risk stratification and preventions of pneumonia.
5. Explain the interaction between lack of pulmonary reserve and anesthesia delivery.
References:

This review examines the impact of aging on pulmonary reserve. It provides an overview of common anesthetic and surgical factors that impose substantial stress on respiratory system in elderly patients; contributing to an increased risk of post operative complications, including respiratory failure.

Physiological aging is associated with dilatation of alveoli, enlargement of air spaces decrease in exchange surface area and loss of supporting tissue for peripheral airways (senile emphysema). Decreased perception of bronchoconstriction and diminished physical activity may result in lesser awareness of disease and delayed diagnosis.

There is no evidence that changes in respiratory system with aging impact day to day function of older patients but the decline in pulmonary reserve function may become evident under circumstances of increased stress, such as during surgery. Established predictive values of a diagnostic test done in young adults cannot be applied to geriatric patients.

This is an older comprehensive review of the aging lung.

7. Understanding Anesthesia and the Impact of Aging on Endocrine and Metabolic Function

Goals:
1. Understand body composition changes.
2. Understand age-related changes in endocrine function.

Objectives:
1. Describe the hepatic and renal changes associated with aging.
2. Describe age-specific changes in the endocrine system and an approach to assessing its functional reserve.
4. Describe consequences of acute electrolyte disorders (e.g. TURP syndrome, including common procedures associated with its occurrence and treatment.)
5. Define malnutrition and perioperative nutrition issues (for instance NPO guidelines).
6. Explain possible consequences of hypoalbuminemia.
7. Describe recommendations for renal, pancreatic and liver transplantation in the elderly patient.

References:

Diabetes


2. Connery LE, Coursin DB. Assessment and therapy of selected endocrine disorders. Anesthesiol Clin North America 2004;22:93-123. *This review addresses the management of a several endocrine disorders during the perioperative period. A large section deals with diabetes (types 1 and 2). The authors point out that diabetes remains the most commonly encountered endocrinopathy. It is noted that patients with either type require more surgical procedures than their non-diabetic counterparts and exhibit greater perioperative morbidity and mortality. The authors conclude with a call for more evidence based guidelines in caring for the ever increasingly encountered perioperative diabetic.*

3. Robertshaw HJ, Hall GM. Diabetes mellitus: anaesthetic management. Anaesthesia 2006;61:1187-90. *This article reviews the anesthetic management of diabetes. Although it does not deal specifically with the elderly it provides a useful overview of glucose management strategies relevant to many older patients. The authors note that in the postoperative period a decrease in catabolism as a result of good analgesia and the avoidance of nausea and vomiting contribute to early re-establishment of normal glycemic control.*

Hepatic

*The liver plays a major role in drug clearance and aging is accompanied by non-pathological changes in physiology both at the cellular and organ levels. Although aging is accompanied by minimal structural changes the authors report a reduction in the clearance of drugs that undergo mandatory oxidation by the microsomal cytochrome P450-dependent mono-oxygenase systems.*

### Renal


*This comprehensive review provides an overview of age-related physiologic changes in the renal system and the impact of these changes during the perioperative period. The most important alterations are decreases in the GFR, decreased urinary concentrating ability, and narrowed limits for the excretion of water, sodium, potassium, and acid. The most important principle for the prevention of renal complications in the elderly surgical patient is maintenance of normal intravascular volume. Meticulous attention must be paid to salt and water balance and to drug dosing. In the event that perioperative renal insufficiency occurs, evaluation and management in the elderly patient are similar to usual practices in a younger individual.*

### Thyroid


*This review article provides an excellent overview of thyroid disease in the elderly, although not specific to the operative patient the information is still relevant. Thyroid disorders are associated with significant morbidity if left untreated. Often symptoms may be not present and may be mistakenly ascribed to normal aging or coexisting disease. Only myxedema coma requires levothyroxine parenterally; all other forms of hypothyroidism can be treated with oral levothyroxine. Low-dose levothyroxine should be initiated and increased gradually over several months. In unstable elderly patients with hyperthyroidism, antithyroid medication can quickly produce a euthyroid state. Parathyroid disease and consequent hypercalcemia and bone loss can occur at any age but is more common after the 6th decade.*

### Calcium Metabolism


*The authors note that the diagnosis of hyperparathyroidism is often difficult because many of its symptoms are difficult to distinguish from the aging process. Furthermore, surgical referral of elderly*
patients with hyperparathyroidism is often deferred because of the perceived risks of general anesthesia, increased age, and comorbidities. It concludes that parathyroidectomy in elderly patients is frequently safe, curative, and beneficial.

Renal and Electrolytes


3. Gravenstein D. Transurethral resection of the prostate (TURP) syndrome: a review of the pathophysiology and management. Anesth Analg 1997;84:438-46. *Although the TURP procedure has become less popular, this review provides an excellent summary of the procedure and potential physiological consequences. It addresses the controversies surrounding the pathophysiology related to the TURP syndrome.*

Transplantation


8. Understanding Anesthesia and the Impact of Aging on Thermoregulation

**Goals:**
1. Understand changes in thermoregulation in aging.

**Objectives:**
1. Describe the risk of hypothermia in aging.
2. Discuss the changing role of fever as an indication of underlying infection in the elderly patient
3. Define proper temperature management in the aged.

References:
   Definitive review of how general and regional anesthesia promote hypothermia in all patients. Also describes the risks, such as infection or myocardial infarction, associated with even mild perioperative hypothermia.

   Excellent review of how aging alters thermoregulation and makes the older prone to hypothermia because of decreased heat production and impaired vasoconstriction.

   Documents that temperature decreases during anesthesia are more severe when general (vs. epidural) anesthesia is used, in a cold (vs. warm) OR, and when the patients are older.

PUTTING IT ALL TOGETHER


Goals:
1. Understand a comprehensive geriatric patient assessment.
2. Understand the value of a geriatric specialist consultation.
3. Understand terms such as functional status, ADL's etc.

Objectives:
1. Define a geriatric assessment, its impact on outcome, and who would benefit from it.
2. Development of ability to administer basic tests of functional status and understand when referral for more sophisticated functional testing is indicated.
3. Describe functional gait assessment and evaluation for the risk of fall.
References:


Geriatric Assessment is important to identify frail and vulnerable elderly oncology patients. The goal of this study was to identify simple screening questions that could be used to identify at risk elders in this population of cancer patients. They examined the questions used in the ADL and IADL tools and found that 6 simple screening questions could identify 98.5% of elders with limitations. This report is very useful for those interested in Geriatric Assessment.

2. Finlayson M, Mallinson T, Barbosa VM. Activities of daily living (ADL) and instrumental activities of daily living (IADL) items were stable over time in a longitudinal study on aging. J Clin Epidemiol 2005;58:338-49. The Aging in Manitoba Longitudinal Study was started in 1971. A specific goal of this study is to address stability of ADLs and IADLs over time and across settings (home and nursing home). It found that certain activities may be used as markers to identify an impending need for a transition in care. For instance difficulty walking outside may suggest the imminent need for in house services. This is a complex article; however it provides interesting data on the ADL and IADL tools and is valuable for those interested in functional outcomes in geriatrics.

3. Fukuse T, Satoda N, Hijiya K, Fujinaga T. Importance of a comprehensive geriatric assessment in prediction of complications following thoracic surgery in elderly patients. Chest 2005;127:886-91. Thoracic surgery can be associated with high morbidity and mortality in frail, elderly patients. The goal of this study was to examine the predictive value of different elements of a comprehensive geriatric assessment. It found that difficulty with activities of daily living (ADLs) and impaired cognition were predictive of complications postoperatively, especially when the operative time was prolonged.

10. Preoperative Assessment in the Elderly: The Perspective of the Anesthesiologist

Goals:

1. Understand what are the patient’s Goals and expectations.
2. Understand the determination of preoperative physical / functional status.
3. Understand the formulation of a complete perioperative plan:

Objectives:
1. Describe indicated recommended preoperative testing in elderly patients.
2. Describe recommended methods of preoperative functional assessment
3. Develop a plan for risk reduction strategies.

References:
   A useful editorial accompanying the article by Dznakic below.

   This prospective study examines the utility of routine laboratory testing in elderly patients. The most prevalent abnormal labs values found in this study of elderly patients, anemia (10%), high creatinine (12%) and hyperglycemia (7%) were not predictive of adverse postoperative outcomes. They conclude that the history and physical should guide selective laboratory preoperative testing.

   A useful but older study reaffirming that routine screening before ambulatory surgery is unnecessary.

   A comprehensive review of the preoperative assessment of the older patient.

   A classic article. In this report the authors found a 10 fold reduction in postoperative death and non-fatal myocardial infarction in high risk vascular patients (mean age 67years) that received beta blockade prior to surgery. Although the role of perioperative beta blockade is becoming
more controversial, this article highlights the importance of developing a comprehensive preoperative plan, even in older very sick patients.


In this large study of patients undergoing cataract surgery, the authors found that for patients undergoing cataract surgery under monitored anesthesia care, there was no benefit to the group who had routine medical testing prior to eye surgery. All patients, however, were followed by a primary care physician, and received testing only when it was appropriate for their ongoing medical care.


ECG abnormalities were found to be common in elderly patients, and were of limited value in predicting postoperative cardiac complications for patients undergoing noncardiac surgery who were hospitalized postoperatively. The authors state that age should not be the sole consideration in ordering preoperative ECGs, instead the presence and severity of comorbidities should be the primary consideration.


Age was not found to be a significant predictor of postoperative adverse events in this elderly population who were followed in the hospital after surgery, (not outpatients). The severity of preoperative comorbidities and ASA classification, need for emergency surgery, and intraoperative tachycardia were predictive.


Goals:
1. Understand the need for a high index of suspicion for common conditions in the face of non-specific symptoms (e.g. agitation).

Objectives:
1. Describe alternative presentations of myocardial infarction, pulmonary embolus and acute abdomen in the elderly population
2. Explain possible diagnostic delays in diagnosis of the acute abdomen in the older patient.
3. Pneumonia.

References:
1. Sigurdsson E, Thorgeirsson G, Sigvaldason H, Sigfusson N. Unrecognized myocardial infarction: epidemiology, clinical characteristics, and the prognostic role of angina pectoris. The Reykjavik Study. Ann Intern Med 1995;122:96-102. These authors found that one third of all myocardial infarctions (MIs) were unrecognized in a population cohort of over 9000 men. The prevalence was more than 5% in the older group over 75 years compared to close to 0% in those under 40 years. In the group with unrecognized MIs, a prior history of angina was associated with a worse prognosis and suggested more severe cardiovascular disease.

2. Kokturk N, Oguzulgen IK, Demir N, Demirel K, Ekim N. Differences in clinical presentation of pulmonary embolism in older vs younger patients. Circ J 2005;69:981-6. This article describes the differences in the clinical presentation of pulmonary embolus in elderly versus younger patients. In the elderly person the presenting symptoms may be subtle or atypical, suggesting a need for increased suspicion in the older patient.

3. Aalten CM, Samson MM, Jansen PA. Diagnostic errors; the need to have autopsies. Neth J Med 2006;64:186-90. In this study, the authors found a major discrepancy between the premortem clinical diagnosis and postmortem autopsy in 39% of cases.

12. Geriatric Trauma

Goals:
1. Understand the distribution of trauma in the elderly.
2. Understand the outcomes and import of triage decisions.
3. Understand the implications of common geriatric injuries as they relate to comorbid conditions (e.g. hip fracture with pneumonia, delirium, subdural hematoma, etc.).

Objectives:
1. Identify common trauma presentations
2. Define principles of triage in the elderly.

References:
This retrospective study addresses the incidence and outcome of elderly car crash victims. Elderly patients in this study had a higher mortality related to injuries sustained. Significant chest injuries were more common in this elderly population compared to younger patients.

2. Pudelek B. Geriatric trauma: special needs for a special population. AACN Clin Issues 2002;13:61-72. This is a relatively simple report providing a comprehensive review of common injuries including discharge planning in the elderly trauma victim. It also includes a case study illustrating important geriatric trauma principles.

3. Perdue PW, Watts DD, Kaufmann CR, Trask AL. Differences in mortality between elderly and younger adult trauma patients: geriatric status increases risk of delayed death. J Trauma 1998;45:805-10. This is a relatively old retrospective study examining outcomes in young and old trauma patients. There was a two-fold increase in early mortality in elderly compared to young patients.

4. Siegmeth AW, Gurusamy K, Parker MJ. Delay to surgery prolongs hospital stay in patients with fractures of the proximal femur. J Bone Joint Surg Br 2005;87:1123-6. This study addressed the controversy surrounding surgical delay for non-medical reasons in elderly patients with hip fractures. In contrast to the study by Moran et al. (see below), this group found that a delay in surgery beyond 48 hours was associated with increased length of stay.

5. Moran CG, Wenn RT, Sikand M, Taylor AM. Early mortality after hip fracture: is delay before surgery important? J Bone Joint Surg Am 2005;87:483-9. This is a prospective study of over 2500 hip fracture patients addressing outcomes with respect to the timing of hip surgery. The timing of surgery on hip fractures remains controversial. This study found no increase in morbidity or mortality in those with surgery delayed for non-medical reasons up to 4 days. However they found that when acute medical conditions delayed the surgery there was a 2.5 times increase in mortality at 30 days. A well-written study worth reading; especially for those responsible for prioritizing surgical case loads.

obtained. They concluded that TBI is a major cause of death and hospitalizations in Wisconsin. Male teens, young adults, and the elderly are high-risk groups for TBI. The authors concluded that preventive measures should be aimed at these high-risk groups.

CHOOSING THE ANESTHETIC

13. Regional vs. General

Goals:
1. Understand the risk/benefit ratio of regional vs. general anesthesia in the elderly.
2. Understand the potential anatomical differences that may influence block placement in the elderly.
3. Understand the differences with regard to neuraxial drug distribution in the elderly.

Objectives:
1. Utilize an evidenced-based approach to anesthetic selection.
2. Describe anatomical changes in the older spine relevant to the administration of neuraxial anesthetic agents.
3. Describe the influence of advanced age on neuraxial drug distribution

References:
A classic article addressing cognitive dysfunction in elderly patients undergoing knee replacement surgery. The authors found no difference between the two groups.


postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. Bmj 2000;321:1493.

The benefits of neuraxial vs. general anesthesia have long been debated. This meta-analysis looks at mortality and morbidity data from 141 published trials. The results suggest that neuraxial anesthesia confers some benefits and reduces some postoperative complications. However, many of the studies included are small and the results have not been replicated elsewhere.


This study specifically addressed the value of regional anesthesia in hip fracture patients. It found that regional anesthesia provided marginal advantages compared to general anesthesia.


This large retrospective study addressed the controversial issue of regional vs. general anesthesia for hip fracture patients. They reviewed over 9000 cases, approximately 6000 general vs. 3000 regional anesthetics. The 30 day unadjusted mortality rates were not significantly different between the two groups. This paper demonstrates that outcomes in hip fractures patients are not heavily dependent on the anesthetic technique.

14. Ambulatory Surgery

Goals:
1. Determine which elderly patients are appropriate for ambulatory surgery
2. Consider evidence for preoperative testing for elderly patients
3. Identify post discharge concerns

Objectives:
1. Describe selection criteria for elderly patients for ambulatory surgery
2. Describe appropriate preoperative testing
3. Identify elderly patients at risk for hospitalization after ambulatory surgery

References: See also Section 10: Preoperative Testing
1. Fleisher LA, Pasternak LR, Herbert R, Anderson GF. Inpatient hospital admission and death after outpatient surgery in elderly patients:
importance of patient and system characteristics and location of care. 
The authors identified several risk factors for inpatient admission or death following ambulatory surgery: more advanced age, prior inpatient admission within six months, surgery performed at a physician’s office or outpatient hospital, and invasiveness of surgery.

Elderly patients were found to have a higher incidence of intraoperative (Odds Ratio = 1.4) or cardiovascular (O.R. = 2.0) events, but a lower risk of postoperative events such as pain, nausea and vomiting or dizziness.

Hospital returns were found to be independent of age and ASA Class. Return visits were more common in Urology patients, but not due to any age-related problems.

A review of patient selection for ambulatory surgery, covering several different conditions, this contains a concise section summarizing the literature on perioperative management of elderly patients undergoing ambulatory surgery addressing both age and preoperative evaluation.

15. Fluid and Blood Administration

Goals:
1. Understand vulnerability of the elderly to hypo- and hypervolemia.
2. Understand indications for perioperative transfusion in the elderly patient

Objectives:
1. Describe methods to recognize fluid overload in the elderly patient
2. Develop an evidence-based approach to perioperative transfusion.

References:
The article reviews pathophysiology and clinical implications of fluid management in the perioperative period. It succinctly describes the endocrine changes related to surgery and their impact on water and electrolyte balance. Consequences of salt and fluid administration in the perioperative period, on cardiovascular, respiratory, gut and renal system, are well described. Furthermore, issues related to regional anesthesia and fluid administration are also discussed. With 150 pertinent references, it is 'must' read for anybody interested in perioperative fluid and electrolyte issues.

   This is a very good review article describing salient changes in renal, water and electrolyte homeostasis with aging. The discussion of anti-diuretic hormone, atrial natriuretic peptide, and sodium and water handling is particularly elegant. Also mentioned are the commonly used medications in the elderly, which can significantly impact the fluid and electrolyte homeostasis. Though it is deficient in specific recommendations, it complements nicely the other two articles.

   Another wonderful review, discussing issues related to fluid and electrolyte administration, in the perioperative period. Describes some of the more important studies and has annotated bibliography. Strongly recommended for the clinician.

16. Procedural Skills - DO NO HARM

Goals:
1. Understand issues in vascular access in elderly patients.
2. Understand issues in positioning of the geriatric patients.
3. Understand the physiology, prevention and management of skin lesions in the elderly.
4. Understand the assessment of the uncooperative patient

Objectives
1. Define the alterations in vascular and perivascular anatomy of the jugular vein.
2. Describe safe positioning in the older operative patient
3. Describe strategies to prevent perioperative skin breakdown

References:
Found that in older patients the internal jugular was frequently directly over the carotid artery.

   *Useful review, applying what is known about positioning to the older patient.*

   *The authors provide a comprehensive, easy-to-read review including the etiology, predisposing factors, grading system, and the current recommendations for the surgical and medical management of pressure ulcers or decubiti.*

**DRUGS**

**17. Understanding Pharmacological Issues in Aging**

**Goals:**
1. Understand age-related changes of pharmacokinetics and pharmacodynamics.
2. Understand significant drug interactions.
3. Understand concept of polypharmacy and the incidence in the elderly
4. To be familiar with commonly prescribed drugs of the elderly.

**Objectives:**
1. Describe age–related changes in pharmacokinetics and pharmacodynamics and their impact on drug effects.
2. Describe impact of age-related changes in the kidneys, liver and volume of distribution and their impact on drug administration.
3. Describe recommended adjustments to dosing of anesthetics in the elderly.
4. Explain how to obtain a valid medication history, including over-the-counter drugs.
5. List recommendations for preoperative administration of prescribed medications

**References:**
   *This is a classic review article, which describes age-related changes in pharmacokinetics. The review is not specific to anesthetic drugs; however, it is a starting point in understanding the changes which can*
impact intravenous anesthetics.

An easy-to-read review article. It starts by reviewing age-related changes in the major organ systems and their impact on pharmacokinetics. The pharmacokinetics of commonly used intravenous and local anesthetic agents is described in a well organized way. Pertinent references are included and recommendations for altering drug dosing in the elderly are succinctly mentioned.

This article is an overview of the influence of age on the pharmacodynamics of drugs used during general and regional anesthesia. The article starts with an overview of effects of aging on cardiovascular and neuroendocrine function and includes a short account of the state-of-the-art in pharmacodynamic modelling. It describes the physiological changes that occur with aging and are associated with increased sensitivity to the effects of anesthetic agents. It complements the article by Sadean and Glass.

This article reviews age-related changes in pharmacokinetics and their clinical relevance. The review emphasizes literature from 1990 through April 2004. It describes the principles and influence of aging on pharmacokinetics. It also describes the effect of these changes on drugs common used in the elderly. It is comprehensive article and a good reference.

This article is oriented more for the primary care physician than anesthesiologists, but it nicely reviews the often adverse consequences of polypharmacy and drug interactions in the older patient.

18. Inhalation Anesthetics

Goals:

1. Understand pharmacokinetic versus pharmacodynamic changes that are relevant to aging and inhalation anesthetics.
Objectives:
1. Describe age-related changes in MAC.

References:
   This paper, together with other studies, illustrates that the MAC of inhalation anesthetics decreases with the age. For example, whereas the MAC of isoflurane for a 5 year old patient is 1%, it is 0.25% for a 95 year old patient.

   This study mathematically calculates expected MAC and MAC at different ages. It suggests that each decade of increased age is associated with a 6.7% decrease in MAC. Although the information is valuable, this is a complex article.

3. Xie, Z; Lanahan, J. In Clinical Anesthesia Procedures of Massachusetts General Hospital. Geriatric Anesthesia. 2006 Edited by Peter Dunn, M.D.
   This chapter describes that protein binding of anesthetic drugs is reduced and longer time required for drug elimination is required in elderly patients.

4. Xie, Z; Lanahan, J. In Clinical Anesthesia Procedures of Massachusetts General Hospital. Geriatric Anesthesia. 2006. Edited by Peter Dunn, M.D.
   This chapter describes the age-related reduction in anesthetic requirements in elderly patients.

19. Intravenous Anesthetics

Goals:
1. Understand principles of administration of sedatives and hypnotics to elderly patients.
2. Understand principles in administration of induction agents.
3. Understand principles in administration of neuromuscular blockers and reversal.

Objectives:
1. Describe approaches to the administration of sedation and anxiolysis to the older patient
2. Provide examples of drugs associated with adverse outcomes that should be avoided in the elderly

References:
   An older article describing the mechanism behind elderly patients’ increased sensitivity to midazolam.

   This is an old but valuable review of the meperidine and its potentially toxic metabolite normeperidine. In general, most geriatricians recommend avoiding meperidine in elderly patients.

   Title can be misleading. The primary focus of the review is on the practical aspects of administering regional anesthesia in the elderly. However, it addresses the use of sedation (effective and safe sedative doses for benzodiazepines and other hypnotics), the pharmacokinetics of local anesthetics, and anatomical and physiological changes associated with age in relation to performance of regional anesthesia. Use of adjuvant (opioids, epinephrine) is also described. Literature cited was current to December 2003.

   Excellent review of the pharmacokinetic and pharmacodynamic changes of aging as it applies to common anesthetic drugs.

   This is a comprehensive review of neuromuscular blockade and the pharmacokinetic and pharmacodynamic changes associated with aging. Cisatracurium and succinycholine appear to have the least alteration in metabolism in older patients. This article provides more pharmacology than most clinical reviews and serves as an excellent reference article.

20. Local Anesthetics
Goals:
1. Understand the differences in the duration and dosing of local anesthetics.

Objectives:
1. Describe responses to local anesthetics in the aging patient.

References:
   This review article critically examines the current recommendations for maximal local anesthetic doses, specifically considering the effect of absorption from various sites of injection (e.g., local infiltration vs. direct nerve block). The author concludes that dosing in elderly patients should be modified, and reduced by a factor of 10-20% based on expected age-related pharmacokinetic and pharmacodynamic changes.

   This editorial accompanying the article below by Ezri provides an excellent review of the hemodynamic effects of spinal and epidural anesthesia in elderly patients.

   This is a prospective study of 80 patients comparing combined spinal epidural anesthesia to plain epidural anesthesia in patients undergoing knee replacements. The authors found that the incidence of hypotension was similar with both techniques.

POSTOPERATIVE CARE

21. Postoperative/PACU Issues

Goals:
1. Understand the differential diagnosis and evaluation of slow emergence.
2. Understand the risk factors and consequences of emergence delirium in the elderly.
3. To understand the implications and etiology of cognitive dysfunction in the PACU.
Objectives:
1. List causes of delayed emergence.
2. Provide recommendations for treating delirium acutely in the PACU.
3. Describe discharge criteria from the PACU.

References (see also Section 22: Delirium):
   This study enrolled 17,638 patients over a period of three years and compared the incidence rates of intraoperative and post op complications in the elderly population were compared with those of younger patients. Elderly patients had a higher incidence of intraop cardiovascular events and a lower incidence of post op events like pain and nausea vomiting.

   This study enrolled 372 patients ≥ 60 years old and for inpatient versus outpatient surgery, and assessed their cognitive function preoperatively and at 7 days and 3 months postoperatively. The authors found that postoperative cognitive dysfunction at one week occurs less frequently after outpatient surgery. They supported the strategy of avoiding hospitalization of older patients when possible.

   This is a prospective study addressing the incidence of and risk factors for emergence delirium in elderly patients. The authors enrolled over 1200 patients and found that preoperative benzodiazepines, and long surgeries were two of several risk factors for emergence delirium.

   This article investigated the effects of delirium in the post anesthesia care unit and the development of postoperative delirium in hip fracture patients. delirium.

22. Delirium and Postoperative Cognitive Dysfunction
Goals:
1. Understand delirium: what is it, how to diagnosis it, and how to differentiate it from POCD and dementia.
3. Understand the impact of postoperative delirium on morbidity and mortality.
4. Understand the economic impact of delirium on health care resource utilization.

Objectives:
1. Describe etiology and incidence of post operative delirium
2. Describe how to assess preoperative risk for postoperative delirium.
3. Provide recommendations to prevent delirium in the older patient
4. Describe postoperative consequences of delirium
5. Describe methods to treat postoperative delirium using non pharmacological and pharmacological methods.
6. Describe the utility of the Confusion Assessment Method for follow up in patients with delirium
7. Discuss possible etiology of POCD and incidence

References:


A well-designed, randomized, controlled trial demonstrating that low-dose haloperidol prophylaxis reduces the severity and duration of postoperative delirium. Unfortunately, the study intervention did not reduce the incidence of delirium.


A systematic review of articles addressing the impact of neuraxial vs. general anesthesia on postoperative cognitive function. The article provides an overview of issues related to postoperative cognitive dysfunction and delirium, including their public health impact, etiology and risk factors. The authors conclude that intraoperative neuraxial anesthesia does not appear to decrease the incidence of postoperative cognitive and delirium. However, they note that many of the studies included had methodological and design issues which prevented a definitive answer.

Three articles that examine intra- and postoperative risks for delirium:


These two studies describe two prediction rules that can be used to assess patients’ risk for postoperative delirium:


*A well-designed clinical trial demonstrating the utility of a non-pharmacological intervention for the prevention of postoperative delirium*

*A landmark article describing the design and validation of the Confusion Assessment Method (CAM). The CAM is one of the standard tests used in studies of postoperative delirium.*

*Although the CAM is a valuable tool for delirium screening in hospitalized patients, it cannot be used in mechanically ventilated patients. This article describes the CAM-ICU, a modification of the original CAM that allows it to be applied in intubated intensive care unit patients, a group at particularly high risk for delirium.*

*An outstanding summary of the broad topic of postoperative central nervous system dysfunction*

*This is a landmark international prospective study investigating the effects of general anesthesia and general surgery on long term cognitive performance in elderly patients using neuropsychometric testing.*

*This is one of the earliest prospective studies demonstrating that cardiac surgery was associated with an increased risk of adverse cognitive outcomes (both stroke and cognitive performance) in elderly patients.*

This prospective study investigated the effect of cardiac surgery on cognitive performance 5 years later and demonstrated that impaired cognitive performance at hospital discharge following cardiac surgery was a predictor for cognitive decline five years later.

23. Acute pain management

Goals:
1. Understand unique issues in geriatric perioperative pain control, including preoperative planning, intraoperative course and postoperative strategies to minimize pain and side effects.
2. Understand the risks/benefits of opioid agonists.
3. Understand the role non-opioid analgesics.
4. Understand the risks/benefits associated with peripheral and neuraxial regional analgesic techniques, including central neuraxial analgesic drug selection.
5. Understand adverse impact of inadequate pain treatment (e.g. delirium).
6. Understand pain assessment strategies in the cognitively impaired.

Objectives:
1. Describe possible treatment strategies for pain in the elderly, including dose adjustment, in the immediate postoperative period.
2. Describe side effects prevalent in the elderly patient exposed to opioid medication and recommended strategies to reduce morbidity.
3. Discuss the pros and cons of meperidine and morphine therapy.
4. Describe use of non-opiate adjuvants in the perioperative period.
5. Describe appropriate peripheral and regional analgesic techniques for the elderly patient perioperatively.
6. Describe approaches to pain assessment in the elderly patient with visual and cognitive dysfunction, including dementia and delirium.

References:
1. Aubrun F. Management of postoperative analgesia in elderly patients. Reg Anesth Pain Med 2005;30:363-79. This is an excellent review of pain management. The author discusses the issues surrounding physiological changes, including a useful chart comparing young with old patients and the expected age-related pharmacokinetic and pharmacodynamic changes. He discusses strategies for pain control within the OR and in the immediate postoperative period.
postoperative period, including both intravenous and epidural modalities. Valuable for both specialists and nonspecialists.

2. Aubrun F, Monsel S, Langeron O, Coriat P, Riou B. Postoperative titration of intravenous morphine in the elderly patient. Anesthesiology 2002;96:17-23. This is a well-done study addressing titration of morphine in the PACU. These authors found that elderly patients had similar requirements for morphine during the immediate postoperative period. This study is well worth reading for anyone involved in the administration of pain medication in the PACU.

3. Aubrun F, Bunge D, Langeron O, Saillant G, Coriat P, Riou B. Postoperative morphine consumption in the elderly patient. Anesthesiology 2003;99:160-5. This is a prospective study comparing postoperative morphine consumption in young and old patients following a hip replacement. They found that the initial intravenous morphine requirement was similar in young and old patients. However, the post-acute requirement for subcutaneous morphine was lower in older patients. An excellent study for those interested pain control in the elderly.

4. Gagliese L, Katz J. Age differences in postoperative pain are scale dependent: a comparison of measures of pain intensity and quality in younger and older surgical patients. Pain 2003;103:11-20. This article compares 3 different pain scales used in the acute postoperative period, comparing young and elderly patients. Their results suggest that verbal pain scales may provide better pain assessments compared with non verbal scales. A useful article describing different types of pain scales.
SUBSPECIALTY AREAS

24. ICU issues

Goals:
1. Understand issues related to triage and resource utilization for potential elderly ICU patients.
2. Understand geriatric outcomes in intensive care.
3. Understand complications associated with geriatric ICU patients.

Objectives:
1. Define resource issues associated with geriatric ICU patients.
2. Define outcomes associated with geriatric ICU patients.
3. Define the diagnosis and treatment of common ICU issues such as delirium and ventilator-associated pneumonia.

References:
1. Somme D, Maillet JM, Gisselbrecht M, Novara A, Ract C, Fagon JY. Critically ill old and the oldest-old patients in intensive care: short- and long-term outcomes. Intensive Care Med 2003;29:2137-43. This prospective study examined the outcomes in old and very old patients admitted to the ICU. Age >75 years and premorbid limitation in activity were important markers for death at 3 months post discharge.

2. Kaarlola A, Tallgren M, Pettila V. Long-term survival, quality of life, and quality-adjusted life-years among critically ill elderly patients. Crit Care Med 2006;34:2120-6. These authors retrospectively looked at over 800 patients over the age of 65 admitted to their ICU over a 5 year period. They suggest that age alone is not a valid reason to withhold ICU care. This article emphasizes again the importance of the functional status in predicting ICU outcome in the aged population.

3. Cuthbertson BH, Scott J, Strachan M, Kilonzo M, Vale L. Quality of life before and after intensive care. Anaesthesia 2005;60:332-9. The aim of this investigation was to study quality of life before and after ICU admissions. The authors assessed quality of life prospectively in 300 patients admitted to the ICU. They found that patients generally had a reduction in quality of life after the ICU. This was more marked in those starting with lower quality scores.

4. Marik PE. Management of the critically ill geriatric patient. Crit Care Med 2006;34:S176-82. This is a recent review article dealing with the management of the critically ill geriatric patients. It provides a good overview of physiological changes and quickly moves on to discuss organ-specific
medical issues. The impact of respiratory problems and cognitive problems is highlighted. Discussion regarding outcomes is eye-opening. Reference list is comprehensive.

25. Chronic Pain Syndromes

Goals:
1. Understand common pain syndromes in the elderly.
2. Understand the role of coexisting psychological issues in pain management of the elderly.
3. Understand the challenges surrounding treatment of the older patient with chronic pain.

Objectives:
1. Define the epidemiology and treatment of common chronic pain syndromes, such as lower back pain, post herpetic neuralgia.
2. Describe the pharmacological therapies available for the treatment of chronic pain management in the older patient
3. Describe the use of adjuvant therapies in pain management

References:


3. Davis MP, Srivastava M. Demographics, assessment and management of pain in the elderly. Drugs Aging 2003;20:23-57. This is an exhaustive review of pain management in the elderly. It is a useful reference guide and methodically addresses all types of pain treatments from nonpharmacological through to the role of tricyclic antidepressants and other nonopioid pain alternatives. A valuable reference guide.


Complete Reference List:

References: 1-141


33. Finlayson M, Mallinson T, Barbosa VM. Activities of daily living (ADL) and instrumental activities of daily living (IADL) items were stable over time in a longitudinal study on aging. J Clin Epidemiol 2005;58:338-49.


