GERIATRICC CURRICULUM

(Geriatric Education Research Initiative and Anesthesia Training of Residents in Core Curriculum)

MAIMONIDES MEDICAL CENTER

DEPARTMENT OF ANESTHESIOLOGY

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INTRODUCTION

The geriatric patient group is the fastest growing demographic group as life expectancies increase. Who is old, and how do we classify them? The government classifies old (geriatric) as anybody over the age of 65. We have further divided the elderly population into young old 65-75 years, middle old >75-85 years, very old >85-100 years and the ultra old >100 years. As the baby boomers age, currently, it is estimated that number of Americans aged 65 and older will more than double, from 35 million (13%) today to more than 78 million (24%) in 2050. Each year the elderly undergo almost 40% (approximately 8 million) of all surgical procedures, including elective and emergency surgery. Furthermore, emergency department and rehabilitation units are disproportionately used by the elderly. To appropriately care for these patients it is necessary to understand the natural physiological changes of aging, the co-morbidities found in the elderly, and the effects these co-morbidities have on the aging process. They are also more likely to suffer a wide range of postoperative complications. To deal with this age group, the provision of high quality, “gerosensitive” care will become even more of a critical issue in the surgical and related specialties.

Despite the higher number of elderly patients having surgery, mortality and morbidity rates have been declining thanks to advances in medical sciences (prevention, early diagnosis, treatment). The old age appears to have less influence on the perioperative morbidity and mortality. Aging is a progressive phenomena characterized by degeneration in both structural and functional reserves of organs and tissues.

The brain undergoes some physical changes with advancing age. It's likely that these physical changes account for at least some of the noticeable cognitive changes. But discovering the exact links has so far proved elusive. Nonetheless, given the evidence accumulated thus far, some

theories have been proposed, and more research is being conducted. To date, only a few studies have attempted to make a direct correlation between the physiologic changes of the brain and cognitive decline and other age-related effects.

The perioperative management of patients undergoing vascular surgery is one of the most challenging and controversial areas in the field of anesthesiology. Much progress has been made in management of vascular patients in three decades. In the 1970s it was recognized that vascular surgery has the greatest risk for perioperative cardiac morbidity. In the 1980s an effort was made to identify patients who were at greatest risk for morbid outcomes. In the 1990s numerous clinical trials were done to study the best anesthetic techniques, sympatholytic drugs, hemodynamic control and analgesia regime to prevent perioperative cardiac and other morbidities. In 2000, endovascular surgery has provided less invasive approaches and alternatives to conventional vascular reconstruction.

Cardiac surgery is now offered to septuagenarians and octogenarians with good results. In fact the elderly may become the majority of cardiac patients in the near future.

Independently of diseases, the aging cardiovascular system is characterized by alterations of cardiovascular performance that may have little relevance at rest, but become of paramount importance under perioperative stress.

Pain management in the elderly is to alleviate the pain and its consequences on the activities of daily living and improve patient functional status and mood behaviors. In the case of acute postoperative pain management it is essential for speeding up recovery and healing, to decrease morbidity and mortality and to minimize the length of hospital stay.

We need to not only understand the medical and social issues related to these patients, but also understand the normal physiological changes in different organs and tissues associated with aging.

To respond to this need for better geriatric training, the American Geriatric Society (AGS) established the Geriatrics for Specialist Project in 1994. Anesthesiology is one of the 10 surgical and related specialties participating in this project. The Department of Anesthesiology at Maimonides Medical center is proud to be selected by the Geriatric Education for Specialty Residents (GESR) program. To achieve the requirements of the GESR program, our Department of Anesthesia has initiated a Geriatric Expansion Project entitled “Geriatrics Education Research Initiative and Anesthesia Training of Residents In Core Curriculum,” (GERIATRICC) which will enable our residents to learn the various aspects of Geriatric anesthesia care.

There is a growing population of elderly patients that require different operations requiring different sub-specialties of anesthesia. For example, at Maimonides Medical Center, the Orthopedic and Vascular Surgery services have a significant number of geriatric patients. These groups of patients usually present with significant concerns for anesthesia because of:

- Physiological changes of aging
- Pre-existing multiple, chronic co-morbid diseases
- Multiple drug therapy
- Type of surgery and the urgency of the same.

All residents are trained how to be safe, competent, and clinically excellent anesthesia consultants. Additionally, our residents are exposed to an array of geriatric patients during all three years of the residency program. Furthermore, there will be a specific rotation and a series of core lectures throughout the training that will address specific issues that pertain to geriatric patients.

GOALS & OBJECTIVES:

As with all subspecialty rotations, we expect a continuum in the development of the resident's professionalism, knowledge base, clinical skills, and interpersonal skills and to integrate his/her practice into the overall health system. Residents are evaluated in each of the six ACGME defined core competencies:

1. Professionalism
2. Medical Knowledge
3. Patient Care
4. Practice Base Learning And Improvement
5. Interpersonal And Communication Skills
6. System-Based Practice

Although the 'goals and objectives' for professionalism, practice base learning and improvement, interpersonal and communication skills, and system-based practice are nearly identical for all the subspecialty rotations, we urge you to read through them for each rotation, as certain rotations have additional goals and objectives in these areas.

I. PROFESSIONALISM

- Demonstrate a commitment to carrying out professional responsibilities with respect, compassion, and integrity.
- Arrive for clinical and learning responsibilities in a timely and punctual fashion.
- Answer pages in a timely fashion.
- Respond to questions, requests for information, follow-up, and other communication in a timely fashion.
- Demonstrate truthful and ethical standards in professional conduct.
    - Adhere to departmental and university policies and procedures.
    - Exhibit honesty in record keeping and medical records.
    - Present information, concerns and suggestions without bias or for personal gain.
    - Report concerns, errors or potential problems to the PACU attending or appropriate authority that are available 24 hours/day-7 days/week.
- Demonstrate sensitivity and responsiveness to patient's culture, age, gender, religion and disabilities.
- Demonstrate ethical principles pertaining to provision or withholding of clinical care, confidentiality of patient information, informed consent, and business practices.
- Value patients' leadership role in their own care.
- Recognize patient vulnerability.
- Cope with diversions and minimize distractions while maintaining vigilance.

II. MEDICAL KNOWLEDGE

- Residents should be able to discuss the various pathophysiological changes in all organ systems due to aging:
- List and have knowledge about age related concomitant diseases
- Discuss fluid and electrolyte management in the anesthetized Geriatric patient
- List the reason for using special precautions while positioning the Geriatric patient
- Discuss the various techniques to reduce blood loss
- Describe different techniques to maintain an appropriate level of anesthesia

Organ System Changes

A) Central Nervous System

Age-related changes in the brain include:

Brain shrinkage
Lost connections
Plasticity
Pathological changes

Brain shrinkage

Throughout adulthood, there is a gradual reduction in the weight and volume of the brain. This decline is about 2% per decade. Contrary to previously held beliefs, the decline does not accelerate after the age of 50, but continues at about the same pace from early adulthood on. The accumulative effects of this are generally not noticed until older age.
Scientists used to think that the reason for brain shrinkage is the loss of neurons. Some past studies estimated that adults lose as many as 100,000 neurons a day. However, improved testing techniques have revealed that the actual loss of neurons is far less significant than previously thought, and may not be occurring at all. The reduction in brain volume is more a function of the neurons themselves and their connections shrinking in size. This atrophy makes them less effective messengers. This new information gives scientists hope that they may eventually be able to repair these dysfunctional neurons.

While the brain does shrink in size, it does not do so uniformly. Studies using MRI and PET technologies show that the frontal lobe seems to be most affected by normal aging. Declines there are likely responsible for the reduced processing speed and mild memory problems typical of normal aging.
The hippocampus, a key area involved in memory, generally remains intact in normal aging. Declines in the volume of the hippocampus and other parts of the medial temporal lobe, visible using MRI, are associated with the development of Alzheimer's disease or other neurodegenerative diseases.
Many other brain structures, such as the visual cortex, suffer no loss in size.

Lost connections

The complexity of the brain is due in part to the intricate system of interconnections between neurons in the different parts of the brain. Neurons communicate with one another via specialized chemicals called neurotransmitters, of which there are several. Changes in this network of communication may account for some of the cognitive changes seen with age. Some of the

connections may be lost, and new connections may not be made as readily. In addition, levels of two neurotransmitters (acetylcholine and dopamine) are thought to decline with age.

Plasticity

On the bright side, the brain has a great capacity for adaptation, modification, and repair. The term plasticity refers to the ability of the brain to modify its structure and function. This capability continues throughout life. For one thing, there is a certain amount of redundancy in the brain. If one network of neurons is damaged or dies, another network can take over the function. The death of neurons can also be compensated for by surrounding neurons sprouting new connections to take the place of the lost ones.

The brain is a dynamic, not a static, system. The neurons respond to mental stimulation and environmental factors. And there is the capacity to respond to age-related changes. It appears likely that cognitive changes are noticed at a point when the compensatory mechanisms of the brain are unable to overcome physical changes taking place. There may be strategies, either with medications, mental exercises, or something else, to enhance the brain's natural capacity for plasticity and thus forestall cognitive declines associated with aging.

Pathological changes

Tangles of tau protein in the brain, a hallmark of Alzheimer's disease, can also be responsible for mild cognitive impairment in older individuals. Postmortem examinations of the brains of non-demented older adults have found a correlation between the number of neurofibrillary tau tangles in memory-related areas of the brain and memory impairment during life. Other changes associated with Alzheimer's disease and other forms of dementia include plaques of a protein called beta amyloid, and loss of synapses and neurons. Most researchers now believe that mild cognitive impairment represents an early stage of Alzheimer's disease.

Age related changes in the nervous system can be difficult to accurately predict because of how systems interact. For example, cardiovascular problems can decrease cerebral blood flow and could be responsible for cerebral dysfunction. Changes in the nervous system could progress so slowly that it goes unnoticed and is non-specific in nature. Nerve cells are lost with age and there is a decrease in conduction velocity. Most reflexes are slowed, but the deep tendon reflexes remain intact. Sleep stages 3 and 4 become less prominent and sleep is more frequently interrupted. However, the amount of sleep loss is minimal. Alterations in proprioception (sense of physical position) can lead to problems with balance and spatial orientation.

Outcomes from geriatric head injury.

The topic of geriatric head injury has received more attention in the literature than has any other aspect of geriatric trauma. Unfortunately, all of it is retrospective in nature and, therefore, suffers from many of the same methodological shortcomings discussed above for the remainder of the geriatric trauma literature. These include lack of a specific age definition for geriatric head injury, lack of standardized definitions for specific sub-populations of geriatric head injured patients, and lack of standardized outcome measures. In addition, much of the geriatric head injury literature either provides insufficient details regarding head injury management, or provides results based upon head injury management that would be considered outdated by today’s standards. Therefore, it is difficult, and perhaps even dangerous, to make meaningful recommendations regarding the triage of current day geriatric neurotrauma patients based upon the existing literature. Despite

these shortcomings, there is little question that outcomes following traumatic brain injury are much worse in geriatric patients than in their younger counterparts.

Vollmer, in a study from the Traumatic Coma Databank, reported on 661 patients, age 15 and older, with severe brain injuries, defined as GCS less than eight. Mortality for the entire series was 38%, but was 80% for patients greater than 55 years of age. Multivariate analysis revealed age to be an independent and significant predictor of death and vegetative outcome, beginning at age 45. Another study examined the effect of age upon outcome in patients with acute subdural hematomas. Mortality was 18% in patients between the ages of 18 and 40, but 74% in patients greater than age 65. Once again, advanced age was noted to be a predictive of poor outcomes. In addition to age, a number of other factors have been examined as potential predictors of poor outcome following head injury in geriatric patients. Not surprisingly, the most extensively studied factor is that of admission GCS. Many other factors predictive of poor outcome have been examined including anatomy of the brain injury (epidural versus subdural), need for craniotomy, subdural hematoma volume, midline shift, pupillary status, and intracranial pressure. None of these factors has been examined in sufficient detail to allow us to make any recommendations regarding their potential role as triage tools in geriatric head injury. “Low” admission GCS is clearly associated with poor outcomes in elderly head-injured patients. Reuter documented a mortality rate of 87% in elderly patients (age > 60) with traumatic intracranial hemorrhage and an admission GCS < 8, though no details regarding head injury management were provided. The available scientific literature, however, does not support the use of a specific GCS that will reliably identify patients destined for poor outcomes.

Cognitive function changes:

List the differential diagnosis of change in mental status

- Dementia
- Depression
- Stroke
- Delirium (CAM test)
- Postoperative cognitive deficit

- Depression, loss of memory, and motor dysfunction. These are caused by dissociation between serotonergic, cholinergic and dopaminergic systems.
- Progressively increased threshold for perception including vision, hearing, touch, joint position sense, smell, pain, and temperature.
- Decline in slow wave or Delta Sleep (deepest level of sleep), increased awakening during nighttime, and increased sleepiness during daytime.
- Memory and reasoning performance decline linearly with age.

Cerebral atherosclerosis, Alzheimer’s disease, dementia, and Parkinson’s disease are more common with advancing age. Most strokes affect those older than 70 years of age.

What is Dementia?

- Dementia is an acquired syndrome of decline in 2 or more cognitive functions; a decline from the baseline. It is different from normal cognitive lapses, delirium, psychiatric illness or other medical diagnoses. Dementia is not an inherent aspect of aging. 1 in 10 persons aged 65+ have dementia and 1 in 2 persons aged 85+ have dementia. The following conditions predispose patients to dementia: Alzheimer’s disease, Parkinson’s disease,

Huntington's disease, Jakob-Creutzfeld disease, and progressive supranuclear palsy. Dementia has other impacts in hospitalized patients: it can affect the course of other diseases, discharge planning, capacity for decision making, end of life issues and may predispose to delirium.

What is Delirium?

Delirium and dementia often occur together in older hospitalized patients. The distinguishing signs of delirium are:

- Acute onset
- Cognitive fluctuations over hours or days
- Impaired consciousness and attention
- Altered sleep cycles.

The mortality of in-hospital delirium is 25-33% and alarmingly it is unrecognized by the physicians 30-50% of the time.

Postoperative delirium:

Postoperative delirium occurs in10-15% of patients >65years of age. Postoperative delirium results in increased mortality and longer hospital stays. Predisposing risk factors are: advanced age, dementia, depression, anemia, alcohol and drug withdrawal, metabolic derangement, acute MI, infection and emergency surgery. Delirium in the hospitalized patient may be the symptom of an unrecognized medical problem. It increases length of stay and readmission rates, and predisposes the patient to other iatrogenic problems (i.e. falls, pressure ulcers). Prognosis for the family: Only 5% of delirium is resolved at discharge, 62% still have symptoms at 6 months

B) Cardiovascular system

Many changes of the cardiovascular system are associated with age. There is a generalized stiffening of the connective tissue, resulting in systolic hypertension and left ventricular hypertrophy, and impaired ventricular diastolic relaxation predisposing to diastolic heart failure. The increased rigidity of the venous system weakens its ability to mitigate the effects of changes in blood volume and distribution on the filling pressures and the preload, rendering the myocardial performance overly dependent on the patient volume status.
Response to beta-stimulation in elderly patients is reduced, even if the number of beta-receptors does not appear to decrease with age. As a result, there is a diminished chronotropic and inotropic response to beta stimulation, limiting increase in cardiac output and oxygen delivery under stress. The baroreceptor response, defined as change in heart rate secondary to a change in blood pressure, decreases with age. Increase of heart rate secondary to the administration of atropine is markedly reduced. The basal sympathetic tone is increased, with a decrease of parasympathetic influence on sinus node function. Aging severely affects the sinoatrial node and the conduction system, resulting often in symptomatic bradycardia and sick sinus syndrome.

Residents should be able to describe and discuss:

- Increase in arterial wall rigidity secondary to atherosclerosis and increase sympathetic activity.
- Hypertension, especially systolic blood pressure

- Left ventricular hypertrophy secondary to systolic hypertension and fibrosis of the ventricle.
- Decrease in CO and SV (controversial)
- Venous compliance is reduced.
- Diastolic dysfunction
- Increased sympathetic activity decreased parasympathetic activity.
- Decreased responsiveness to beta adrenergic stimulation
- Lesser inotropic and chronotropic effects to vasopressors.
- More susceptible to orthostatic hypotension because of decreased baroreceptor reflex.

C) Respiratory system

- Decrease in elasticity of chest wall.
- Weakness of muscles of respiration due to loss of muscle mass
- Decrease in alveolar gas exchange surface
- Decrease in CNS responsiveness to hypoxia and hypercarbia
- Protective reflexes such as coughing and swallowing are reduced leading to repeated pulmonary aspiration and infections.
- Trachea and large bronchi increase in size while small airways decrease in diameter.
- PFTs:
    - small increase in dead space
    - increase closing capacity
    - vital capacity and closing volume are decreased
    - residual volume increased
    - RV/TLC ratio is increased (giving barrel chest appearance)
    - TLC decreased
    - FRC slightly increased
    - FEV 1 decreased
- More V/Q mismatching
- PaO_2 decreased about 0.4 mmHg/year
- Decreased HPV response because of stiff pulmonary vasculature

For all the above reasons, elderly patients are more susceptible to hypoxemia and any residual anesthetic may exert an additive effect.

D) Renal function

- Almost half of the glomeruli are either gone or nonfunctional by 80 years of age.
- GFR is reduced to 60ml/min by age 80 (120ml/min in young age)
- Perioperative renal failure following cardiovascular surgery carries an incidence of 0.1% - 50% with reported mortality of 20% - 90%.
- Acute tubular necrosis accounts for 90% of cases of perioperative renal failure. Almost half of these cases will require acute dialysis.

E) Hepatic function:

-↓in hepatic mass and blood flow

-Hepatic function decreases in proportion to decreased liver mass

-↓in albumin production
-↓rate of biotransformation
-↓plasma cholinesterase levels

F) Endocrine System:

-Decreased Basal and maximal oxygen consumption
-Heat production decreases and heat loss increases
-Increased incidence of Diabetes mellitus
-Decreased ability to handle glucose loads
-Neuroendocrine response to stress- slightly decreased
-Elevated circulating norepinephrine levels

G) Thermoregulation and Basal Metabolic Rate:

-Poor thermoregulation
-Heat production ↓
-Heat loss ↑
-More prone for intraoperative hypothermia and its adverse effects
-Neither shiver nor vasoconstriction till temperature has fallen to 35.2° Celsius

H) Pharmacokinetic and Pharmacodynamic changes with Aging.

Drug distribution in the elderly is affected, among other factors, by decrease in total body water and lean body mass, decrease in serum albumin and increase in alpha-1 glycoprotein, increased volume of distribution due to increased fat and decreased renal and hepatic clearance

- Drugs that are highly protein bound, such as propofol, etomidate, and fentanyl, may have a greater free fraction and an exaggerated clinical effect.
- Water-soluble drugs such as digoxin may have increased action due to a reduced initial volume of distribution.
- Fat-soluble drugs (for example benzodiazepines) may have an increased volume of distribution and consequently a prolonged duration of action.
- Decreased liver function with age may result in greater bioavailability of drugs with high intrinsic hepatic clearance.
- Volume depletion and decrease in renal function may reduce the clearance of many drugs, including beta-blockers.

Pharmacodynamics are also altered in the aged because of all the organ system changes rendering these patients more sensitive to a given blood level of intravenous or inhalational anesthetic.

Concomitant Diseases

Diabetes

Most of the patients coming for vascular procedures have long standing diabetes and a good number of these patients have poorly controlled diabetes. Diabetes is a multi system disease and affects all organ systems and tissues.

The risks associates with Diabetes are:

- wound infections (Diabetic foot)

- Microvasculitis leading to gangrene of extremities, coronary artery disease, renal insufficiency or ESRD, retinitis to blindness, and CVA.
- Neuropathies including peripheral neuropathies and autonomic neuropathies causing orthostatic hypotension and syncope.
- Delayed gastric emptying with increased risk for aspiration
- Diabetic autonomic dysfunction also leads to inadequate heat production, conservation, increased heat loss, and reduced heat tolerance as a consequence the elderly are vulnerable to heat stroke and hyperthermia.

Neurological and Psychiatric Disorders

- Impairment of memory and decreased cognitive and intellectual function.
- Depression
- Dementia
- Delirium
- TIA
- Strokes

Emphysema

- Severe COPD
- Steroid dependency
- Oxygen therapy at home.

Renal Insufficiency or ESRD

- HTN
- CHF
- Anemia
- Electrolyte disturbance
- Coagulation disturbance

Coronary Artery Disease

- HTN
- Prior myocardial infarction (Ischemic Heart disease)
- Angina
- CHF (Congestive heart failure)
- Prior CABG
- Prior PTCA
- Cardiac arrhythmias
- Valvular heart disease (AS, AI, MS or MR)

Peripheral vascular disease:

- HTN
- Coexisting cardiovascular disease
- Aorta and large arteries stiffen
- Aorta lengthens and becomes tortuous
- Peripheral arteries- less resilient and tortuous
- Decreased elasticity of veins and arteries

Arthritis:

- Difficulties in positioning
- Difficult airway
- Drug interactions with anti-inflammatory medications

List the reasons for using special precautions while positioning the Geriatric patient

- Osteoporosis
- Limited mobility due to arthritis
- Fragile skin, putting EKG pads and tape
- Padding for pressure points
- Supporting head in supine as well as in lateral position
- Concern about shoulder surgery in Beach chair position – Benzold Zarich Reflex, hypotension and bradycardia and how to prevent and treat it

Describe different techniques to maintain appropriate levels of anesthesia and explain the advantages and disadvantages.

- MAC
- GA with ETT or LMA
- Regional Anesthesia -- is preferred way to provide anesthesia for Orthopedic Surgery on Extremities for its definitive advantages over GA such as:
    - Extremity is completely anesthetized and immobilized due to motor block
    - Do not need to give repeated local injections
    - Patient has no pain after surgery for extended period
    - Early dismissal for outpatients
    - Less nausea and vomiting
    - Less drowsiness
    - Less urinary retention
    - Tracheal intubation not required
    - Theoretical decrease in incidence of reflex sympathetic dystrophy
    - Greater patient satisfaction

REGIONAL ANESTHESIA:

Neuraxial Anesthesia:

- Anatomy of the vertebral column and to understand the physiology of spinal and epidural anesthesia.
- How to perform various techniques of spinal and epidural anesthesia at different levels.
- Difficulties faced due to osteoporosis, osteophytes, calcification of ligaments and deformity of spine
- The pharmacology and safe dosages of various local anesthetics for spinal and epidural anesthesia.
- How to insert and use continuous spinal and epidural catheter.
- How to evaluate the level of anesthesia by pin prick or temperature sensation
- Be familiar with complication of the spinal and epidural anesthesia and know how to treat them, such as hypotension, bradycardia, and post-op spinal headache

Non-neuraxial Anesthesia

- Understand the concept of plexus anesthesia popularized by Dr. Alan P. Winnie
- Understand the anatomy of brachial plexus for upper extremities and lumbar and lumbar-sacral plexus for lower extremities as well pathways of major nerves and their motor and cutaneous distribution
- Should be familiar with various approaches with:

Upper extremity blocks

- Interscalene
- Supraclavicular
- Infraclavicular
- Axillary
- Midhumeral
- Around Elbow
- Wrist Block

Lower extremity blocks

- Femoral nerve
- 3-in-1
- Lumbar plexus
- Sciatic Nerve
  - Classic approach
  - Posterior approach
  - Anterior approach
  - Gluteal fold approach
- Popliteal nerve
  - Lateral approach
  - Posterior approach
- Saphenous nerve – various sites of block at above and below knee
- Ankle – five nerves around the ankle
  1. Sural
  2. Saphenous
  3. Superficial Peroneal
  4. Deep Peroneal
  5. Posterior Tibial

- Should be familiar with various techniques of block
  - Paresthesia
  - Pulsation – only axillary
  - Nerve stimulation
  - Transarterial – only axillary
  - Infiltration
  - Most popular ultrasound technology

- Should know how to select local anesthetics based on duration of surgery and safety of doses

- Should be familiar with the selection of other medication that can be mixed with local anesthetics to make the block faster onset and long-lasting, such as adding sodium bicarbonate or epinephrine

- Should know how to assess the effects of block
- Should be familiar with the complications related to local anesthetics, various approaches and techniques of block, as well as how to treat them
- Should be familiar with rescue blocks in case block is incomplete or failed
- Should know how to perform continuous technique of plexus anesthesia by inserting stimulating or non-stimulating in-dwelling catheter for intra-op or post-op pain management

Intravenous Regional Anesthesia (Bier Block - mostly performed for upper extremity hand surgery)

- Be familiar with the technique of Bier block and how the double tourniquet works
- Be familiar with what local anesthetics, its doses, and volumes can be used safely
- Complications related to Intravenous regional anesthesia and how to treat them
- Preparedness for failure of Intravenous regional anesthesia with alternate methods

Regional Anesthesia and Anti-coagulation – Postoperative DVT and PE are the complications with highest morbidity, especially in elderly orthopedic patients

- Residents should be familiar with thromboembolism prophylaxis medication
- Should be familiar with the concerns of performing RA on patients on anti-coagulants
- Should be able to thoroughly evaluate the patient preoperatively for their medications, their last dose, and their current lab work including PT/PTT and INR
- Be familiar with ASRA guidelines (Published in *Regional Anesthesia and Pain Medicine*, June 2003: Regional Anesthesia in the Anticoagulated Patient: Defining the Risks) so as to know:
  - When to remove indwelling catheter
  - When to start anti-coagulation therapy post-op after neuraxial and non-neuraxial anesthesia

III. PATIENT CARE:

Residents must be able to provide patient care that is compassionate, appropriate, and effective for the treatment of geriatric patients. Residents are expected to evaluate the patient pre-operatively by performing a thorough examination to assess the patient's medical condition.
They should be able to:

- Obtain complete medical history and physical examination
- Check if patient is medically optimized
- Check the list of medications patient is taking
- Check all the lab workup
- Obtain appropriate medical consult
  - Request additional cardiac work up if deemed necessary like Echocardiogram
- Consult with attending anesthesiologist
- Evaluate the airway, for degenerative changes of the cervical spine and TMJ and for glottic narrowing
- Follow NPO guidelines

PREOPERATIVE EVALUATION

Elderly patients have a high probability of undiagnosed or already determined cardiovascular, pulmonary, endocrine and oncological problems and they all should be addressed in the anesthesia evaluations. All the neurological preoperative changes, such as a motor weakness, weak reflexes, muscle tone, and sensory changes, such as a numbness, paresthesia, and vision and hearing impairment should be clearly documented for clinical and medico-legal purposes.

Preoperative evaluation of cognitive function:

Screening for cognitive decline may include the following tests:

- Mini-Cog
  - 3 Item Recall
  - Clock Drawing Test
- MMSE
- Animal Naming
- Digit Span
- Orientation Questions

For the preoperative Cognitive Function Assessment we used the following tools at our institution:

Assessment tools for Cognitive function:

Testing Time points: PRE-OP (MiniCog) and POD 1 (CAM).

*PACU (after 2 hrs. of anesthesia end time)/POSTOP (any time on the DOS), and POD# 2 (CAM) testing *as feasible.

If a patient is assessed with delirium and it is possible to do so, the Resident should continue postoperative evaluations.

PRE-OP:

I. Mini-Cog: (Tool to assess general cognition) TO BE PERFORMED PREOPERATIVELY ONLY. (Total Scoring 0-5, <3=abnormal)

1. Short term recall of three objects (0 - 3 pts).
   Name 3 objects. Tell the patient to repeat them back to you. (If the patient can't name all three, you repeat them again and ask the patient to repeat them). Wait 3 minutes before asking the patient to recall the objects.

   The objects are: Apple, table, penny.

   Give one (1) point for each correct answer for the first try only.

   a._____ b._____ c._____

   PLUS

2. Clock drawing test (0 or 2 pts)
   a. Ask the patient to draw a clock and place 1 - 12 correctly on the clock face.
   b. Ask the patient to draw the hands at 11:20 on the clock face.

POST-OPERATIVELY:

II. Confusion Assessment Method: (CAM) Tool to assess delirium.

The three important components for assessing delirium are:

1. Detailed history
2. RN input
3. Bedside exchange/assessment

A positive CAM test requires:

BOTH (1+2)

1. Acute onset, duration, and severity, with fluctuation of symptoms-waxing and waning appearance-(historical-speak with NURSE or family members).

AND

2. Inattention: test with 'months backwards from December', or 'spell own name backwards'-(bedside test).

WITH EITHER

3. Disorganized thinking (hallucinations or delusions, extremely circumferential speech, difficult to follow) (historical).

AND/OR

4. Altered levels of consciousness (hypervigilant, alert, lethargic, somnolent, comatose).

Apart from the cognitive function assessment as outlined above, residents are expected to evaluate the patient preoperatively by performing a thorough examination to assess the patient's medical condition.

They should be able to:

- Obtain complete medical history and physical examination
- Check if patient is medically optimized
- Check the list of medications patient is taking
- Check all the lab workup
- Obtain appropriate medical consult
    - Request additional cardiac work up if deemed necessary; such as an Echocardiogram
- Consult with attending anesthesiologist
- Evaluate the airway, inclusive for degenerative changes of the cervical spine and TMJ and for glottic narrowing
- Follow NPO guidelines

Preanesthesia assessment for ambulatory geriatric patients:

Although elderly people represent only 12 percent of the United States population, individuals 65 years of age or older undergo almost one-third of the 25 million surgical procedures performed annually (of which, over 50 percent are performed in the ambulatory setting). Therefore, every anesthesiologist in contemporary practice eventually becomes a sub-specialist in geriatric medicine, with a special responsibility for delivering cost-effective health care to older adults. The Anesthesiologist's first interaction with the elderly patient starts with the pre-anesthesia assessment, when the patient is scheduled for ambulatory surgery or a medical procedure,

continues through the day of surgery, and finally ends with the post-operative follow-up by a phone call on the next day following surgery.
The pre-anesthesia evaluation of an elderly patient is best accomplished several days before the surgery. An evaluation in a pre-anesthetic clinic is advantageous and provides the patient with the additional opportunity to meet with the anesthesia staff to discuss any medical concerns and learn about the anesthetic plan for the surgery. In addition, that visit will allow the anesthesia staff to conduct a detailed history and physical, explore the elderly patient's co-existing medical conditions, and obtain the necessary laboratory investigations, which should not be performed solely because of the advanced age. Those additional tests should be tailored according to the invasiveness of the surgery and the severity of the co-existing diseases; involving the cardiovascular, pulmonary, nervous, hepatic and renal systems.
A discussion about anesthetic techniques and risks can reduce patient anxiety. The visit also provides the opportunity to refute preconceived negative beliefs about the safety of anesthetic techniques such as spinal and regional anesthesia.

Some specific areas and questions to be addressed during the visit might include:
• What is the patient's mental status? Is the patient able to answer coherently, or is the family answering for him or her? Will regional techniques and outpatient surgery be feasible?
• Does the patient have cardiac disease? Coronary artery disease is prevalent in elderly patients, and it may be unrecognized due to limited function prior to surgery. Is a prior cardiac work-up available? Why was it performed? Is more needed?
• Assessing functional capacity - this may provide an excellent estimate of reserve. For instance, can the patient walk up and down stairs with and without groceries?
• Does the patient have pulmonary disease? Is he or she short of breath in the clinic or lying flat? Document the patient's oxygen saturation on room air.
• Is the patient hypertensive? This may alter cerebral autoregulation and cause requirements for higher systemic pressure intraoperatively. Make sure to document baseline blood pressure.
• Is the patient markedly anorexic, dehydrated or very frail (e.g., in a wheelchair)? Or does the patient appear young and vigorous for his or her age?
• Does the patient have an understanding of their medications?
• Has the patient had a prior surgery? How did he or she tolerate the anesthesia? Were there complications that may influence the choice of the next anesthetic, such as confusion or congestive heart failure? Post-operative cognitive dysfunction is quite common amongst the elderly, even after a regional anesthetic.
• What are all the medications the patient is taking at present? Polypharmacy is common in the elderly. Knowledge of the same helps to understand and prevent adverse drug interactions.

Preoperative evaluation of the geriatric patient for cardiothoracic, vascular and orthopedic surgical procedures

Preoperative evaluation of these patients begins with a thorough evaluation of the cardiovascular status and likely co-morbidities. As the likelihood of adverse perioperative events increases with advancing age, preoperative assessment of organ function reserve is of paramount importance in the elderly.
The other factors for risk stratification for these patients include the magnitude of risk of the planned procedure (for example single off-pump coronary revascularization vs. complex aortic reconstructions requiring deep hypothermic circulatory arrest), and the patient's overall functional capacity. Only after these factors are analyzed in detail can an effective perioperative anesthetic

plan be formulated and a realistic risk/benefit analysis is proposed to the patient for informed consent.

In particular, the elderly cardiac patient is at increased risk of morbidity and prolonged hospitalization from perioperative stroke and neurocognitive dysfunction, prolonged postoperative mechanical ventilation and postoperative onset of atrial fibrillation.

Patients having cardiothoracic and vascular surgery have a high incidence of coexisting diseases, all of which should be assessed and if possible optimized before surgery.

- CAD
- DM
- HTN
- Cigarette smoking
- Advanced age
- Renal insufficiency or failure

Coronary Artery Disease

- CAD is the leading cause of perioperative morbidity and mortality at the time of peripheral vascular surgery.
- Less than 10% of patients with PVD have normal coronaries.
- 50% of these patients have advanced or severe coronary disease.
- The overall perioperative MI and death is 4.9% and 2.3% respectively.
- The perioperative period presents an opportunity to optimize pharmacological management, perform diagnostic and therapeutic interventions to decrease perioperative risk and long term risk for cardiovascular events.

Goals of Perioperative Cardiac Workup

- To determine the status of ventricular function and the amount of myocardium at risk for ischemia.
- To design an intraoperative management plan to reduce ischemia.
- Plan for post operative care.
- To determine if beta blockers, statins, alpha 2 agonist, PTCA, and CABG are required preoperatively.

Clinical Markers:

- Clinical Predictors of Increased Perioperative Cardiovascular Risk (Myocardial Infarction, Heart Failure, Death)

Major

Unstable coronary syndromes

- Acute or recent myocardial infarction with evidence of important ischemic risk by clinical symptoms or noninvasive study
- Unstable or severe angina (Canadian class III or IV)

Decompensated heart failure

Significant arrhythmias

- High-grade atrioventricular block
- Symptomatic ventricular arrhythmias in the presence of underlying heart disease
- Supraventricular arrhythmias with uncontrolled ventricular rate

Severe valvular disease

Intermediate

Mild angina pectoris (Canadian class I or II)

Previous myocardial infarction by history or pathological Q waves

Compensated or prior heart failure

Diabetes mellitus (particularly insulin-dependent)

Renal insufficiency

Minor

Advanced age

Abnormal ECG (left ventricular hypertrophy, left bundle-branch block, ST-T abnormalities)

Rhythm other than sinus (e.g., atrial fibrillation)

Low functional capacity (e.g., inability to climb one flight of stairs with a bag of groceries)

History of stroke

Uncontrolled systemic hypertension

It appears reasonable to wait 4-6 weeks after MI to perform elective surgery.

Functional Capacity

Estimated Energy Requirements for Various Activities

1-4 METs
Can you take care of yourself?
Can you take care of yourself?
Eat, dress, or use the toilet?
Walk indoors around the house?
Walk a block or two on level ground at 2 to 3 mph or 3.2 to 4.8 km per h?
Do light work around the house like dusting or washing dishes?4-10 METsClimb a flight of stairs or walk up a hill?
4-10 METsClimb a flight of stairs or walk up a hill?
4-10 METsClimb a flight of stairs or walk up a hill?
Climb a flight of stairs or walk up a hill?
Walk on level ground at 4 mph or 6.4 km per h?
Run a short distance?
Do heavy work around the house like scrubbing floors or lifting heavy furniture?
Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a baseball or football?>10 METsParticipate in strenuous sports like swimming, singles tennis, football, basketball or skiing?
>10 METsParticipate in strenuous sports like swimming, singles tennis, football, basketball or skiing?
>10 METsParticipate in strenuous sports like swimming, singles tennis, football, basketball or skiing?
Participate in strenuous sports like swimming, singles tennis, football, basketball or skiing?

Perioperative cardiac and long term risks are increased in patients that are unable to meet 4 Met demand during most normal daily activities.

Surgery Specific Risk

Cardiac Risk Stratification for Non-cardiac Surgical Procedures

High (Reported cardiac risk often greater than 5%)

- Emergent major operations, particularly in the elderly
- Aortic and other major vascular surgery
- Peripheral vascular surgery
- Anticipated prolonged surgical procedures associated with large fluid shifts and/or blood loss

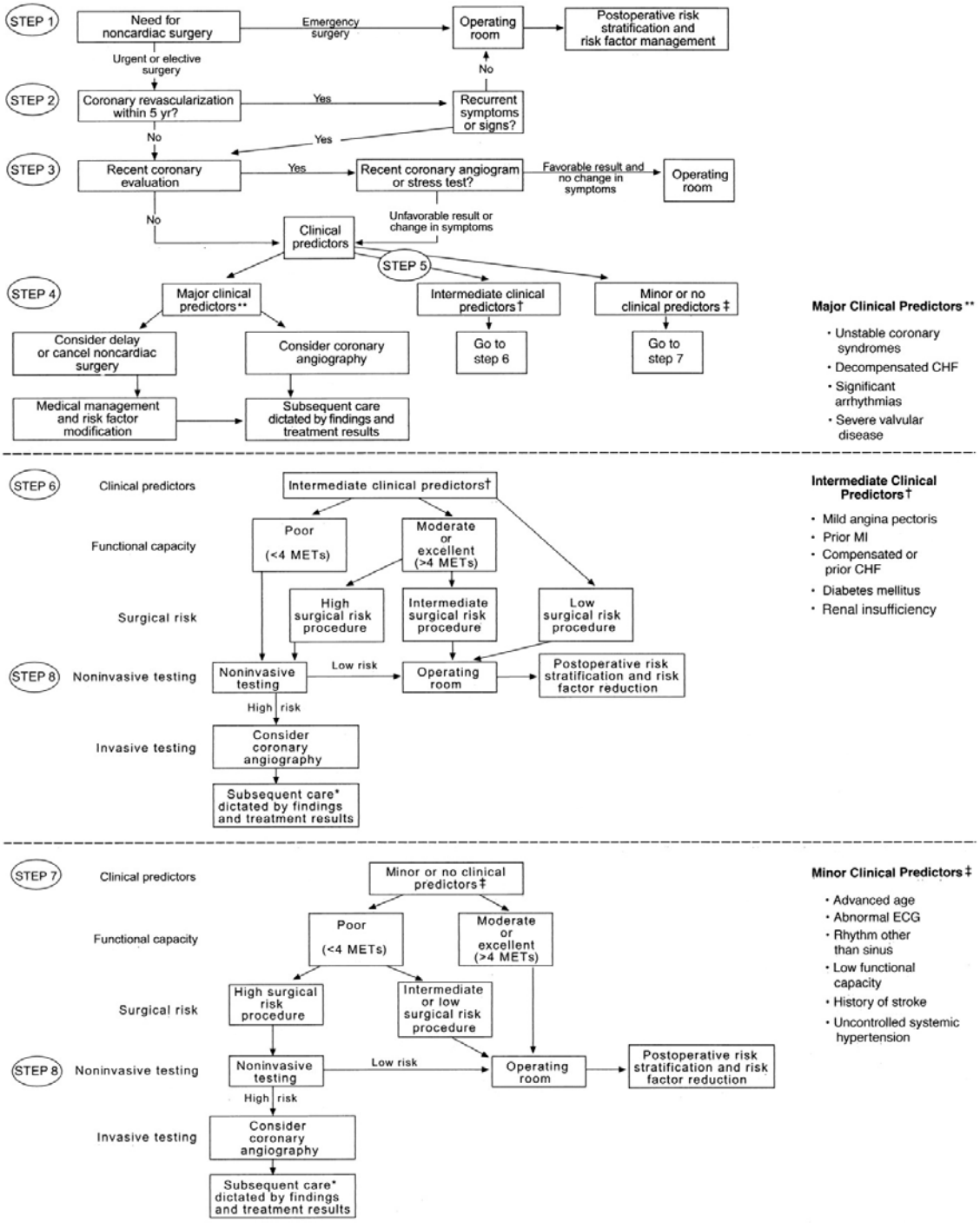
Intermediate (Reported cardiac risk generally less than 5%)

- Carotid endarterectomy
- Head and neck surgery
- Intraperitoneal and intrathoracic surgery
- Orthopedic surgery
- Prostate surgery

Low (Reported cardiac risk generally less than 1%)

- Endoscopic procedures
- Superficial procedure
- Cataract surgery
- Breast surgery

Stepwise Approach to Preoperative Cardiac Assessment



Assessment of Cardiovascular Risk

Resting 12 lead EKG

- Q waves or prior MI if present, one should compare it with old EKG
- Dysrhythmias for example, A-fib should have a better rate control.
- 50% of vascular patients with CAD have normal resting EKG.

Exercise EKG

- A cost effective method for screening for CAD.
- Inability to achieve target heart rate because of poor functional capacity, beta blocker therapy, elderly with hip and knee disorders, chronic lung disease, previous stroke.

Holter Monitor

- Before 1980s used to detect arrhythmias
- Only 1/3 cost of DTI
- Disadvantage is inability to detect ischemia in patients with baseline EKG abnormalities. E.g. LBBB, RBBB, LVH with strain, Pacemaker dependency and digitalis effect.

Echocardiogram

- A qualitative measurement of LVF, EF, Valvular function, and regional wall motion abnormalities.
- Stress Echo (dobutamine, dipyridamole)
- Sensitivity is 80%-90%
- Specificity is 80%-90% for predicting perioperative cardiac morbidity.

Myocardial Perfusion Imaging

- Dipyridamole thallium imaging
- Normal: complete perfusion on first and second images
- Myocardium at risk: First image hypoperfusions, second image normal perfusion.
- Fixed perfusion defect: Hypoperfusion in first and second images means old infarct or scarred myocardium.

Radio Nucleotide Ventriculography

- It only measures EF.
- Cardiac cath

Preoperative Interventions

- Coronary Bypass Grafting: CABG is rarely indicated simply to get a patient through noncardiac surgery. However, data has shown that patients who have undergone CABG prior to a noncardiac operation have much reduced morbidity.
- Percutaneous Coronary Intervention: The Risk of perioperative cardiac morbidity is relatively low in high risk patients treated with PTCA preoperatively. Considerable controversy regarding optimal time interval between PTCA and noncardiac surgical procedure. The available data suggest noncardiac surgery should be delayed for 6 weeks after stent placement. Surgery within 6 weeks of stent placement is associated with extremely high morbidity and mortality from MI from stent thrombosis and major bleeding from anti platelet therapy.
- Medical Therapy:
  Beta-blockers: Current studies have suggested that appropriately administered beta-blockers reduce perioperative ischemia and may reduce the risk of MI and death in high risk patients. When possible, beta-blockers should be started days or

weeks before elective surgery with the doses titrated to achieve a resting heart rate between 50 and 60 beats/min.
Alpha 2 agonists may have similar effects in myocardial ischemia, infarction and cardiac death.

Preoperative management of specific cardiovascular conditions:

- Stage 3 hypertension: (systolic blood pressure greater than 180mmHg and diastolic pressure greater than 110mmHg) should be controlled before surgery and an effective regimen can be achieved over several days to weeks prior to surgery.
- Valvular heart disease: symptomatic stenotic lesions are associated with perioperative CHF or shock.
- Symptomatic regurgitant valve disease is usually better tolerated preoperatively and may be stabilized preoperatively with intensive medical therapy and monitoring.
- Myocardial disease: Dilated and hypertrophic cardiomyopathy is associated with an increased incidence of perioperative HF. Management is aimed at maximizing preoperative hemodynamic status and providing intensive postoperative medical therapy and surveillance.
- Arrhythmias and Conduction Abnormalities: The presence of an arrhythmia or cardiac conduction disturbance should provoke a careful evaluation for underlying cardiopulmonary disease, drug toxicity, or metabolic abnormality. Therapy should be initiated for symptomatic or hemodynamically significant arrhythmias, first to reverse an underlying cause and second to treat the arrhythmia.
- Implantable Pacemakers or ICDs: The type and extent of evaluation of a pacemaker or ICD depend on the urgency of the surgery, whether a pacemaker has unipolar or bipolar leads, whether electrocautery is bipolar or unipolar, the distance between electrocautery and pacemaker, and pacemaker dependency. ICD devices should be programmed off immediately before surgery and then on again postoperatively.

Preoperative management of pulmonary diseases:

- COPD and chronic bronchitis are common. PFTs in the presence of severe pulmonary disease can be obtained. A preoperative ABG must be available for severe COPD patients. A short course of steroids may be considered. Regional anesthesia is strongly recommended and should be considered for appropriate surgical procedures.

INTRAOPERATIVE MANAGEMENT:

Intra-operative considerations for the geriatric patients to minimize the impact on post-operative cognitive dysfunction:

- Avoid excessive use of sedatives, hypnotics, narcotics and muscle relaxants
- Consider regional anesthetic techniques, whenever it is appropriate.
- Avoid drugs like antihistamines, or anticholinergics
- Appropriate antibiotic prophylaxis, to prevent infection.

- Avoid hypoxia, hypotension and hypoperfusion!
- Avoid dehydration
- Avoid hypothermia
- Avoid metabolic/endocrine derangements like hypo/hyperglycemia, hyponatremia, hypocalcemia, hypothyroidism and uremia

General principles to consider regarding the use of anesthesia drugs and techniques:

Inhalational agents:
The MAC off the inhalational agents decreases with advancing age. This has been shown repeatedly for different inhalational agents. Gregory and associates noted that the MAC off decade halothane is highest in the newborn and the lowest in the elderly. The MAC of the newer agents, like desflurane and sevoflurane has also been shown to be age -related. Rampill and colleagues noted that for patients between the third and fifth decades, the desflurane anesthetic requirements declined to 83 percent of third decade MAC. Smaller MAC values of sevoflurane have also been noted in elderly patients compared with the values reported for children and adults. These results are consistent with the thesis that aging has a general effect on the anesthetic requirements for all agents. To obtain a rough estimate of MAC in the geriatric patients, the published MAC the value of inhalational agents is decreased by 4% for every decade of age over 40 years. For example, the MAC of inhalational agent in an 80 years old patient is 84%. This is obtained by the average formula {100% - (4% x 4 decades)}.

Intravenous drugs:
The apparent sensitivity of the CNS to intravenous drugs is also increased in elderly patients. Both pharmacodynamic (plasma concentration-drug response relation) and pharmacokinetic (drug uptake, tissue distribution, metabolism, elimination) factors may play a role, the balance of which depends on the particular drug involved.
For thiopental sodium, propofol and etomidate, the dosages required to reach the uniform EEG endpoint decreases significantly with age. However, it has been suggested that the increased sensitivity to these drugs with aging relates more to differences in pharmacokinetic than to pharmacodynamic. For example, the reduction in the initial distribution volume for both these drugs results in higher serum concentration after a given dose. This contributes to the lower dose requirements in elderly patients. An increase in the volume of the distribution of steady state has been shown for thiopental sodium, producing an increase in the terminal half-life. The decrease in the clearance of etomidate is consistent with the decline in hepatic blood flow in the elderly, since etomidate clearance depends on hepatic blood flow.
The plasma concentration of benzodiazepines required to achieve the desired pharmacologic effect is lower in elderly patients. The prolonged terminal elimination half-life of diazepam reflects an increase volume of distribution. Sensitivity to midazolam is also increased in elderly patients. For example, a dose of 0.3 milligram per kilogram was sufficient for an anesthetic induction in 100% of not-medicated patients age over 60 years, compared to 0.5 mg per kilogram which did not induce anesthesia in 40% of younger not-medicated patients. Elimination half-life is longer and total clearance of midazolam is reduced in elderly vs. young patients.
The dose requirements of narcotics decrease significantly in the elderly. The dose requirement of fentanyl decreases 50 percent from age 20 to age 88. The alteration in those requirements is primarily a function of alternate brain sensitivity (pharmacodynamic response). The elderly patient's increased sensitivity to narcotics was shown in many studies. (3)

Local anesthetics:

Reduced requirements for local anesthetics may be seen in elderly patients. For example, there is the greater segmental spread of local anesthetics in elderly patients undergoing epidural anesthesia. Serum levels of local anesthetics, increased, and thus it is suggested that the amount of local anesthetics should be reduced in elderly patients. Similarly, for spinal anesthesia, it has been demonstrated that the time of maximal spread is shorter in older patients. A number of reasons were suggested for the reduced local anesthetic requirement including:

1. Progressive occlusion of the intravertebral foramina with increasing age so that local anesthetic solutions injected epidurally have a greater longitudinal spread.
2. Reduced vertebral column height leads to lower dose requirements for spinal anesthesia.
3. Deterioration of myelin sheath, results in faster penetration.
4. Decreased CNS neuronal population.
5. Decreased number of axons in the peripheral nerves.
6. Alterations in the pharmacokinetics of local anesthetics in elderly patients. (3)

Intra-operative care for ambulatory geriatric patients

Extra caution should be used in positioning of these patients. Presence of osteoporosis predisposes them for fractures, even with maneuvers which do not cause excessive strain on the skeletal system in younger patients. Among various logistic considerations, geriatric patients take longer to accomplish many tasks. Thus, more time must be allowed for pre-procedure preparation. Also, older patients' skin may be fragile, so adhesive tape should be used with caution to avoid torn skin. Extra padding should be used on procedure tables to prevent compression sores. The elderly are less agile and may require equipment aids (e.g., chair raisers or footstools). Many elderly are hearing impaired, so verbal and written post-procedure instructions may foster comprehension.

Monitoring

In addition to the ASA standard monitors, the Bispectral index monitoring (BIS®) is frequently helpful. BIS is helpful in assessing the adequacy of depth of anesthesia along with the clinical signs and allows for more reliable titration of anesthetic agents and also facilitates faster emergence. Geriatric patients are prone to rapid heat loss in the operating room even during short procedures, which requires close monitoring of core temperature.

Short acting medications

When giving anesthesia to the geriatric patient, the agents of choice should have a rapid onset, short half-life, with minimal active metabolites and limited side effects. Time should be allowed for slower circulation times. One should avoid using standard dosages calculated on an mg/ kg basis. The bolus administration of medications frequently produces unwanted respiratory depression and hypotension. Likewise, slower administration of an agent and allowing more time for peak effects often achieves the desired goals with less overall dosing.

Propofol is a rapid, short-acting alkylphenol with few side effects. Induction using 1.2 to 1.7 mg/kg in the elderly (versus 2.0 to 2.5 mg/kg in younger patients) produces a rapid onset of anesthesia (less than one minute) lasting five to 10 minutes. There is an age-related decrease in Propofol clearance, resulting in a decreased maintenance anesthetic requirement with age. Propofol produces dose-dependent cardiovascular and respiratory depression, leading to great decreases in systemic blood pressure when used for induction in elderly patients. These effects

can be minimized if Propofol is injected slowly with sufficient time allowed to achieve the full effect of the dose, thereby decreasing the total dose.

Etomidate is a rapid, short-acting carboxylated imidazole derived hypnotic. It is a good choice for inducing anesthesia in the hemodynamically tenuous elderly because it possesses less cardiovascular depression than the barbiturates. Rapid recovery is due to the extensive hydrolysis of etomidate to inactive metabolites, but clearance is dependent on hepatic blood flow. Disadvantages of using etomidate include a high incidence of postoperative nausea and vomiting (decreased with prophylaxis with an antiemetic drug) and a postoperative suppression of adrenocortical function; seen with infusion of this sedative-hypnotic.

Fentanyl in doses of 0.5-1 mcg/kg IV is usually necessary to blunt painful stimuli like intubation and incision. Because the elimination half-life of fentanyl is significantly longer in elderly patients, compared to young patients (roughly 945 min and 265 min, respectively), a small dose may produce respiratory depression and bradycardia for a longer time in the elderly.

Midazolam is a common drug used for conscious sedation. Due to increased sensitivity in the elderly and decreased clearance of this agent, smaller doses and more delayed increments must be used. Older patients require lower doses for any given effect; in many cases as little as 50 percent of the expected "standard" dose.

Other short acting agents

Although Sevoflurane, Desflurane, and Rocuronium are also preferred short acting anesthesia medications, attention should be directed toward reducing the concentration or the dosage for the elderly patients.

Delirium is more common in elderly post surgical patients.
The risk of delirium may be increased with agents such as midazolam and or anticholinergics. There is evidence that interventions such as repeated orientation, maintaining sensory aids and familiar family contacts are key factors in delirium prevention.

Intraoperative Management of Patients undergoing Cardiac Surgery:

Induction of anesthesia for cardiac procedures:

Elderly patients have a deficient thermoregulatory system, and tend to become hypothermic very rapidly at the often frigid operating room temperature. Every effort should be made not to unnecessarily expose the patient, intravenous fluids should be routinely warmed, and warm-air devices should be employed early and liberally to prevent hypothermia. These patients almost routinely have osteoarthritis problems and/or prosthetic joint replacements and placement on the operating table should be slow and deliberate. All pressure points should be padded, and the patient asked for the least uncomfortable position on the operating table. Sedatives, if necessary, should only be administered after the patient is set on the operating room table. Benzodiazepines should be avoided or used judiciously, since some of these elderly patients may become confused and combative after their administration. Placement of large-bore intravenous lines should always be preceded by infiltration of local anesthetics, in order to avoid unnecessary hypertension and tachycardia in patients with likely coronary artery disease.
Aging patients often have brittle, frail veins with loose subcutaneous tissue, and skin drag may make intravenous line insertion problematic. It is often more realistic to place relatively small-gauge intravenous catheter for induction of general anesthesia, and place larger bore intravenous catheters after induction of general anesthesia or rely on larger bore central lines for volume infusion during the case.

Since these patients frequently have stiff, calcified vessels or are often downright vasculopaths, insertion or arterial lines requires patience and skill, and use of ultrasound visualization techniques, especially in the absence of a peripheral pulse, is often required.
Elderly patients often have rhythm and conduction disturbances, and placing external defibrillator/pacing pads on the chest before induction is often warranted. Head positioning for orotracheal intubation should take into account the possibility of arthritis of the cervical spine, and it's better to resort early to techniques alternative to conventional laryngoscopy (such as fiber optic bronchoscope and video laryngoscope), in order to avoid unnatural and excessive neck movements.

Placement of central venous lines can be challenging in these patients for several reasons. The lateral movement of the head to access the internal jugular vein is often severely reduced. Repeatedly feeling the carotid pulse to facilitate the location of the jugular vein is not advisable, given the likelihood of the presence of carotid plaques and the possibility of vagal response. The utility of the carotid pulse as a landmark for internal jugular cannulation is dubious anyway, given the often tortuous course of these vessels in the elderly, and the frequent position of the internal jugular vein over and not lateral to the carotid artery.
Guidewire placement in the pulmonary artery should be performed carefully since bundle branch blocks and conduction defects may be more common in the elderly. Elderly patients with aortic stenosis, in particular, may not tolerate at all the loss of sinus rhythm sometimes associated with the placement of central lines and they become profoundly hypotensive.

These patients often present difficult problems at induction.
Elderly patients coming for cardiac surgery are often already on multiple cardiac medications with low therapeutic index (such as beta-blockers, calcium-channel blockers and ACE-inhibitors), that can predispose them to cardiac instability.
They often come volume-depleted to the operating room in consequence of, among other factors, sodium restriction, inadequate intravenous fluid replacement therapy and diuretic therapy. Increased basal sympathetic tone only partially compensates for this hypovolemic state. In consequence of this, when the sympathetic tone is greatly reduced by the administration of anesthetic agents, and with the reduced baroreflex response of the elderly, severe hypotension can occur. The higher the reliance on the patient's sympathetic tone for cardiovascular homeostasis before induction, the greater the degree of hypotension at induction. All anesthetic agents will, to different extents, hinder sympathetic tone, and possibly produce profound hypotension. Dose requirements of all anesthetic and hypnotic agents must be reduced because of age-related changes in pharmacokinetics and pharmacodynamics.
Etomidate is the agent that provides the greater degree of hemodynamic stability at induction. Propofol and isoflurane, on the other hand, can cause profound hypotension in the elderly. Narcotics and benzodiazepines in high doses can be used separately for induction of general anesthesia. Their administration together at the same time can create a deleterious synergistic negative inotropic effect.
Care must be taken in the transition between spontaneous and controlled ventilation. Hyperventilation may cause an acute reduction of the venous return and preload that the aged patient cannot tolerate, given their increased reliance on preload for cardiac performance.

Monitoring

As knowledge of the preload conditions is fundamental for the intraoperative care of these patients, monitoring devices such as a pulmonary artery catheter and transesophageal echocardiography (TEE) should be used liberally. Besides providing real-time visual information on the filling condition of the left ventricle, TEE gives invaluable information on the presence and amount of atheromas in the aorta. Presence of extensive and mobile atheromatous plaques in the aorta is a strong predictor of perioperative neurological complications, and the surgical approach may have to be modified in light of data obtained from the TEE interrogation of the aorta.

Maintenance of Anesthesia

Both the inhalation and narcotic-based general anesthetic techniques are acceptable if conducted judiciously. Surgical stimulus often changes much faster than the anesthetic depth, and sooner or later some degree of hypotension and hemodynamic instability will occur. While in a younger patient fluid administration would probably be the first therapeutic intervention, this may not be suitable for elderly patients, who often have left ventricular diastolic dysfunction and be predisposed to congestive heart failure even in the presence of an acceptable left ventricular systolic function. A sensible approach is to guide fluid therapy following closely TEE and pulmonary catheter data, try to minimize changes in anesthetic depth, and rely on vasoactive infusions rather than boluses in order to gradually correct hemodynamic abnormalities. This is particularly important for off-pump coronary revascularization procedures, which are commonly performed in the elderly and frequently necessitate marked displacement and torsion of the heart, resulting in acute and severe hemodynamic instability. In these situations it is crucial to maintain a proactive approach without overcorrecting very acute but transient abnormalities. Above all to be avoided is left ventricular distension and acute pulmonary edema due to a sudden and excessive increase in systemic vascular resistance resulting from overaggressive bolusing with vasopressors. Crash conversion to a pump run in these cases carries a high morbidity and mortality.
In reducing incision size and postoperative pain, minimally invasive and robotic approaches to cardiac surgery could possibly benefit the elderly patient. On the other hand, the added level of complexity added to the procedure may prolong pump run and operative times, with negative impact on overall results.

Intraoperative management of patients undergoing orthopedic surgical procedures

Residents work with and are closely supervised by the Attending Anesthesiologist. Residents are expected to:

- Perform IV line placement
    - Difficult due to poor and tortuous veins
    - How to select the site of the placement and size of the angiocath for the case
- Apply standard ASA monitors and choose additional monitors as needed.

    - EKG: least expensive, should be performed in diagnostic mode rather than monitoring mode (which filters out ST segment changes), EKG morphology should always be assessed with hard copy, Lead II + V5 detect 80% of ischemia, Leads II + V4+V5 detect 96% of ischemia, Leads II+V3+V4+V5 for maximal detection of ischemia, computerized ST segment analysis.

- Arterial line: For beat to beat blood pressure monitoring, blood gases for pulmonary function, coagulation study and serial electrolyte and HCT testing.
- PA Catheter: Quantitative increase in PCWP of 10 mm of mercury or greater. A number of studies showed it is an insensitive monitor for ischemia.
- TEE: Most sensitive monitor for new regional wall motion abnormalities, decreased systolic wall thickening, ventricular dilatation. Pre-induction and induction events are missed. Monitoring of EKG and Echo increase the sensitivity for detection of myocardial ischemia.

- Manage Airway
  - Re-evaluate the airway for easy-difficult intubation
  - Ventilate the patient with a bag and mask; may be difficult if they are edentulous and/or have a beard.
  - Prepare and position for known and unexpected difficult Airway

- Manage fluids and electrolytes as elderly patients tolerate over/under hydration poorly.
- Positioning of the patient for surgery or anesthetic technique and may require analgesia
- Manage the maintenance of anesthesia- make a clinical judgment to select the appropriate technique:
  - MAC for the surgery or as an adjunct to Regional Anesthesia
  - GA with ETT or LMA
  - Regional

Regional Anesthesia in the OR

a) How to Prepare for Regional Anesthesia:
   - Residents are expected to prepare the OR just like for any other surgical case including airway equipment and emergency medications
   - IV fluid preferably with a micro-drip – not to overload the patient with fluid
   - Prepare for IV sedation – Propofol infusion
   - Make use of Regional Anesthesia cart which contains essential equipment to perform RA block safely in the OR or the preoperative holding area

b) Residents should be able to perform:
   - Spinal Anesthesia through midline and paramedian approaches, while the patient is sitting or in the lateral decubitus position, and able to select Hyper, Iso or Hypobaric spinal anesthesia
   - Epidural Anesthesia at different levels through midline or paramedian approach
   - Upper Extremity Blocks
   - Lower Extremity Blocks
   - IV Regional anesthesia for Hand surgery
   - Rescue Blocks
   - And select appropriate Local Anesthetics for that particular Block

<u>Special considerations for Orthopedic Surgery:</u>

- Techniques to prevent blood loss by:
  - Use of tourniquet

- Deliberate Hypotension; usually avoided in elderly

- Use of Methylmethacrylate cement during hip and knee joint replacement, may cause transient drop in blood pressure and it can be corrected with Ephedrine 5-10 mg IV or volume replacement.

- Positioning of the patient by appropriately supporting the head and neck and by applying padding to pressure points.

- To prevent intraoperative hypothermia by aggressively warming the patient with forced air blanket, warming the fluids and blood

- To prevent infection: to avoid poor wound healing and prevent infection of the prostheses by giving appropriate antibiotic prophylaxis prior to incision, avoiding unnecessary traffic in the OR, laminar flow ventilation to remove airborne particles and maintaining normothermia.

Special considerations for Vascular Surgery

Carotid Surgery:

Epidemiology: 1.2 million strokes or TIA's each year in the U.S.A. Greater than 150,000 deaths each year and it's the third leading cause of death. CEA introduced in 1954 as a preventive measure for occlusive disease.

Physiological Considerations:

Carotid disease is due to atherosclerosis. Most common site is the bifurcation of vessels. Ischemia is often due to embolic phenomenon. During ischemia collateral flow is critical.

Principle pathways: Circle of Willis, extracranial anastomotic channels, leptomeningeal communications.

The Symptomatic Patient:

- Definition of stroke: The sudden onset of a focal, nonconvulsive neurological deficit
- Amaurosis fugax
- Transient Ischemic attack (TIA) which resolves within minutes to an hour and with no deficit at 24 hours
- Completed stroke

Treatment Options:

- Established for selected patients

Surgical therapy

- Carotid Surgery (CEA)
- Angioplasty and stenting
- Under Investigation: EC/IC Bypass

Medical Therapy

- Aspirin: Relative risk reduction with aspirin; 31-58% with high dose, and18% with low dose.
- Dipyridamole and low dose Aspirin.
- Ticlopidine slightly more effective than aspirin (4.3 vs. 3.3 TIA/ stroke per year). More side effects are seen with this drug.
- No significant difference between Aspirin and Warfarin (Mohr 2001).

Carotid Endarterectomy:

A surgical procedure which involves the removal of the diseased intima and portion of media of the carotid artery to prevent secondary stroke.

Indications:

>70% in symptomatic patients
50- 69% in asymptomatic patients with low risk
>60% in asymptomatic patients with favorable surgical risks

Preoperative Evaluation

CEA has an inherent risk of perioperative stroke and cardiovascular events. 25% strokes associated with CEA occur during the intra-operative period. 33% mostly embolic; some hemodynamic in origin. Recent data from the NASCET reports a 6.5% rate of stroke and death. 1.1% rate of death, and 0.9% disabling stroke. Increased risk for stroke is most strongly associated with an active neurological process prior to surgical intervention.

Other risk factors for poor neurological outcome:

Hemispheric vs. retinal TIAs
Left sided procedure
Ipsilateral ischemic lesion on CAT scan
Contralateral carotid occlusion
Impaired consciousness
Poor collaterals
An irregular or ulcerated plaque
CEA with CABG

Monitoring

Standard ASA monitors
Continuous lead II, V5
Arterial line
PA cath and TEE may be considered in patients with symptomatic disease or recent MI

Monitoring

Awake patient	Likely the gold standard for neurological monitoring. However, there is absence of prospective data that will compel one to choose this method of neurological monitoring
EEG	Neurological changes may correlate with EEG. However, there is a fairly high rate of false positives for discriminating ischemia with the EEG
SSEP	Probably not any better than the EEG, but more complex. May be a better indicator of subcortical ischemia
Stump Press	Poor sensitivity/specificity
TCD	TCD may be beneficial for assessing hemodynamic ischemia, shunt function, embolic phenomenon, hyperperfusion syndrome
Oximetry	High false positive rate
JvO2	Sensitivity, specificity and intervention thresholds not determined

Anesthesia Options

General Endotracheal Anesthesia-

- Greater need for shunt placement while artery is clamped
- EEG monitoring or transcranial Doppler monitoring

Regional Anesthesia-

- Lesser need for shunt placement
- Decreased operating time and hospital stay, more cost-effective
- monitoring of patient motor and vocal response to instructions
- No need for EEG or transcranial Doppler

Anesthetic Management

No compelling advantage has been demonstrated with either regional or general anesthesia. Technique should optimize perfusion to the brain, minimize myocardial stress and allow rapid recovery. Choice is often strongly influenced by the surgeon's preference and the anesthesiologist familiarity with a specific technique. In a recent study, sevoflurane and desflurane provided quicker extubation times and recovery profiles after CEA c/w isoflurane with no significant perioperative differences in CI and ST segment analysis. Propofol and narcotics may be associated with hypotension

Regional Technique

A regional technique for CEA necessitates the correct combination of patient, surgeon and anesthesiologist. CEA requires block of cervical nerves C2- C4. Superficial cervical block, deep cervical, epidural and straight local or a combination of these have been utilized successfully

General ET Anesthesia

- ETT vs. LMA
- Baseline EEG done pre-induction
- Maintain BP at high end of pts normal range
- STP/Forane may have cerebral protection
- Avoid hypocapnic vasoconstriction
- Often done as “anesthesia-lite”.
- Carotid cross- clamping
- Vagal stimulation with carotid retraction- Rx w/ anticholinergic or lidocaine infiltration at the carotid body
- Heparin (5000- 10000 U) before cross clamping
- Shunt must be placed due to neuro/ EEG change
- Keep BP 20%-30% above normal BP of the patient to perfuse across Circle of Willis
- Unclamping- reflex bradycardia & vasodilatation
- Postoperative neuro checks & airway compromise
- Hypertension: Nitro/Nipride/ Esmolol/ Nicardipine
- Hypotension: Fluids/ phenylephrine/ ephedrine
- Bradycardia: Glycopyrrolate/ Atropine/ lidocaine
- Tachycardia: Deepen anesthesia /esmolol

Modalities of cerebral protection:

Surgical- placement of a shunt during x-clamp

Physiologic- Treat hyperglycemia, maintain hypervolemia, hypertension and hemodilution in specific case scenarios like cerebral aneurysm.

Maintenance of normocarbia.

Mild hypothermia 33-34°C

Anesthetics:

Volatile anesthetics: isoflurane and sevoflurane associated with lower critical blood flow compared to halothane and enflurane.

Etomidate: shown to worsen outcome in animal models.

Barbiturates: shown to improve ischemic injury.

Propofol: animal studies have produced mixed results.

Abdominal Aortic Aneurysm (AAA)

Approximately 40,000 open procedures per year are done in USA for AAA patients. The common Etiologies are: Genetic Infection, infection, inflammation and trauma. The first case was done in 1951 by Dubost. The perioperative mortality for elective infrarenal AAA is 2-4%. For ruptured AAA, the overall mortality is 90%. Screening for AAA may not be very cost effective but it reduces the risk of rupture by 55%. Elective AAA repair is recommended for aneurysms greater than 5.5 cm. For aneurysms between 4 and 5.5 cm surveillance is needed. Any increase in size (0.5 cm/6 months) or symptomatic aneurysms is an indication for surgery. Aortoiliac occlusive disease for limb salvage surgery perioperative mortality is low.

Aortic Crossclamping

Pathophysiology of X-clamp depends on:

- level of X-clamp
- extent of CAD and myocardial function
- Blood volume and distribution
- activation of sympathetic system
- anesthetic agents and techniques

Hemodynamic Changes

- ↑Blood Pressure
- ↑Segmental wall motion abnormalities secondary to impaired subendocardial perfusion
- ↑SVR
- ↑Left ventricular wall tension
- ↓Ejection fraction
- ↓Cardiac output
- ↓Blood flow
- ↑PCWP
- ↑CBP
- ↑Coronary blood flow

Metabolic Changes

- ↓ Total body oxygen consumption
- ↓ Total body carbon dioxide production
- ↑ Mixed venous oxygen saturation
- ↓ Total body oxygen extraction
- ↑ Epinephrine and norepinephrine
- Respiratory alkalosis
- Metabolic acidosis

Therapeutic Interventions

Afterload reduction

- Sodium nitroprusside (arterial dilator)
- Inhalation anesthetics
- Amrinone
- Shunts and aorta to femoral bypass

Preload reduction

- Nitroglycerin
- Controlled phlebotomy
- Arterial to femoral bypass

Renal Protection
- Acute renal failure is 3% for elective infrarenal AAA
- 80-90% reduction in renal blood flow in thoracic X-clamp
- In infrarenal X-clamp there is 38% decrease in renal blood flow and 75% decrease in renal vascular resistance and redistribution of blood flow to cortex
- Acute tubular necrosis is the pathology of renal failure after AAA repair
- Factors influencing renal dysfunction:
    - RI preoperatively is the strongest predictor of post operative renal dysfunction
    - ↓ Renal blood flow after X-clamp
    - ↓ Plasma volume
    - Embolization of atherosclerotic debris
    - Surgical trauma to renal arteries

Preventive Measures
- Fluid Administration
- Mannitol
    - improve renal cortical blood flow
    - reduces ischemia induced renal vascular endothelial
    - cell edema and vascular congestion
    - scavenger of free radicals
    - ↓ rennin secretion
    - ↑ renal prostaglandin synthesis
- Loop diuretics
- Drugs to augment renal perfusion e.g. Fenoldopam, a selective dopamine type 1 agonist preferentially dilates renal and splanchnic vessels

<u>Aortic Unclamp</u>:
Hemodynamic Changes:
- ↓ Myocardial contractility
- ↓ Arterial blood pressure
- ↑ Pulmonary artery pressure
- ↓ Central venous pressure
- ↓ Venous return
- ↓ Cardiac output

Metabolic Changes:
- ↑ Total body oxygen consumption
- ↑ Lactate
- ↓ Mixed venous oxygen saturation
- ↑ Prostaglandins
- ↑ Activated complement
- ↑ Myocardial depressant factors
- ↓ Temperature
- Metabolic Acidosis

Therapeutic Interventions

- Adequate volume administration
- ↓ Vasodilators
- ↓ inhalation anesthetics
- Vasoconstrictor drugs
- Gradual release of clamp
- Reapply X-clamp for severe hypertension
- Sodium bicarbonate for severe metabolic acidosis
- Hyperventilation for mild to moderate metabolic acidosis
- Temperature control by warm fluids, heating blankets, and airway filters

Anesthetic Techniques

A. GA
B. Combined light GA with epidural
C. Stable hemodynamics
D. Metabolic and temperature homeostasis
E. Blood conservation techniques
F. Preoperative autologous blood donation
G. cell saver
H. acute normovolemic hemodilution
I. cross matching of 4-6 units of PRBC
J. Postoperative pain management
K. Extubation is not attempted in patients with supraceliac X-clamp greater than 30 minutes, patients with poor baseline pulmonary function, and in patients requiring large volumes of blood or crystalloids during surgery.

Endovascular AAA (EVAAR)

Pioneered by Parodi in the early 90s. Selection of patients depends on:
CT angiography or MRA
- Ability of the graft to replace aneurysms and properly seal native aorta (shape of aneurysms, involvement of renal and iliac artery, size and shape of the neck of aneurysm)
- Ability to deliver the devise to and across aneurysm
  - Angulation of aneurysm
  - Size of femoral and iliac arteries
  - Tortuosity of femoral and iliac arteries
- Ability of patient to compensate for vascular occlusion

Almost 60% of patients maybe able to have EVAAR

Preoperative Evaluation

Same as for open procedure. EVAAR is considered an intermediate risk. Special attention should be paid to renal function by comparing preoperative creatinine levels.
If IV dye was used for diagnostic testing and there was an increase in creatinine levels elective EVAAR should be postponed for at least 2 weeks

Perioperative Outcomes

Mortality and major morbidity: Compared to open procedure 0-2%. Mortality < 5%, whereas for OAR is 5.4 -8%.

- Cardiac: EVAAR has less effect on hemodynamics because there is no X-clamping of aorta. Morbidity is <5%.
- Coagulopathy: Consumption of coagulation factors and platelets because of endoleak. Decrease in the platelet count occurs in the first week. Increase in FDP is seen.
- Renal: 6% of all patients with normal renal function suffer from significant decrease in creatinine clearance after EVAAR. 2% of the patients require dialysis. Causes of decrease in renal function:
    - IV contrast dye
    - Limit amount of dye
    - IV hydration
    - Preoperative IV dye studies and surgery time interval more than 2 weeks
    - MRA or gadolinium base contrast study for high risk patient
    - N-acetyl cosine (mucomyst) PO
    - $NaHCO_3$ infusion half an hour before dye use
    - Hemodynamic instability
    - Embolic, Renal artery thrombus or dissection.
- Vascular Exclusion: No perfusion of major aortic branches after EVAAR. Hypogastric artery- abdominal complaints, IMA- bowel ischemia, Artery of Adamkiewitz- distal spinal cord ischemia
- Endoleaks:

Type 1: inadequate proximal and distal seal
Type 2: backflow from collaterals such as lumbar arterial branches
Type 3: defects in the fabric of graft seal failures where 2 grafts overlap
Type 4: secondary to porosity of graft fabric. Usually stops after reversal of heparin

Type 1&3 are corrected as they are detected by placement of additional grafts.
Type 2&4 are observed over weeks and months before any intervention is considered.
Type 2 leak is treated by embolization.

Endoleaks are important as it can expand and cause symptoms and even rupture of native aneurysm.
Endoleaks occur in 20% of EVAAR and account for second surgical intervention.

Anesthetic Techniques

- GA
- Spinal
- Epidural
- Local with IV sedation

Goals

-patient must lie still for 1-3 hours
-adequate hydration

-anticoagulation
-serial HCT
-tight control of BP possibly lowering BP at the time of device deployment
-tight glucose control

- Advantages of Regional Anesthesia
  A. short ICU or hospital stay
  B. Less use of myocardial depressant drugs
  C. ↓ alteration of pulmonary mechanics
  D. ↓ catecholamine release
  E. Early detection of anaphylactoid or anaphylactic reactions
  F. ↓ blood loss

Peripheral vascular surgical procedures: (PVD)

Peripheral vascular disease of the lower extremities is an important cause of morbidity that affects 10 million people in the U.S.A. PVD occurs in 5% of adults older than 50 and in 20% of adults older than 70.
Intermittent claudication is the most common symptom. Other symptoms include numbness or weakness in the leg, aching pains in the feet or toes while addressed, non-healing ulcers on the leg or foot, cold legs or feet and skin color changes of the leg or feet.
In most cases the presence of PVD is the sign of systemic atherosclerosis, which puts these patients at high risk of stroke, myocardial infarction, and cardiovascular death. Risk factors for capital PVD includes: smoking, HTN, hyperlipidemia, diabetes, family history of cardiac or vascular disease, obesity and sedentary lifestyle.

Diagnosis

- History of physical examination
- Ankle brachial index
- Arterial duplex
- Angiography
- MRA

Treatment Options

Conservative treatment

- Cessation of tobacco use
- Exercise program
- Modification in lipoprotein and Cholesterol abnormalities

Medications

Pentoxifylline (trental)
Cilostazol (pletal): phosphodiesterase III inhibitor, Pletal is found to be significantly more effective in improving walking distance than Trental.
Aspirin.
Heparin

Surgery

Surgical bypass is the gold standard for extensive vascular occlusive disease, but endovascular interventions, including percutaneous transluminal angioplasty and stent placement, are being used more frequently, particularly in patients with significant comorbid conditions.

Angioplasty vs. Bypass Surgery for PVD

Angioplasty

Advantages:

- Offers faster recovery.
- Requires shorter hospital stay.
- Requires local with sedation.
- May be repeated if necessary.
- May be combined with surgery.
- Allows preservation of saphenous veins for future use (CABG and extremity bypass).

Disadvantages:

- Lower primary patency rates.
- Re-interventions due to restenosis may be necessary.
- Cost-benefit ratio for severe advanced PVD is debatable.

Bypass Surgery:

Advantages: Considered gold standard. Has long-term patency.

Disadvantages:

- Higher rate of morbidity.
- Potential for systemic heparinization.

Anesthetic Management:

Local with IV sedation: All angioplasties are done under local with IV sedation. Short acting anesthetics should be used. Benzodiazepine should be avoided as it can cause confusion in elderly patients. Benadryl is useful alternative. Incremental doses of narcotics are a better choice. Propofol should be used if needed as an infusion. Hemodynamic and oxygenation should be monitored closely.

General Anesthesia: Surgical bypasses can be done under general anesthesia if there is no contraindication. Etomidate is a good agent for induction combined with narcotics.

Regional Anesthesia: Spinal, epidural, CSE.
Most vascular patients are on anticoagulants or antiplatelet medication, regional anesthesia is contraindicated in these patients.

Peripheral Nerve Block: For patients who are on anticoagulants or antiplatelet medications peripheral nerve blocks under ultrasound guidance can be done. For lower extremities bypasses the combination of sciatic nerve block, femoral nerve block and saphenous nerve block can be done safely.

Combined CEA and CABG procedures:

One of the more difficult decision matrices regards the patient who presents with simultaneous disease of the carotid and the coronary vessels. Best available evidence suggests that doubling of risk of death or stroke if performed as a single anesthetic as opposed to a staged procedure. In a staged procedure risk is related to which procedure is performed first: If CEA is performed first, the risk of MI increases. If CABG is performed first, the risk of stroke increases

New Therapies

Carotid stenting and Angioplasty: the procedure involves the placement of a saline filled balloon, pre-loaded with a stent under angiographic guidance and applying 15atm for 3mins, anesthetic technique is sedation.

Drawbacks: profound bradycardia, high incidence of strokes from the angiography alone.
SAPPHIRE (Stenting and Angioplasty with Protection at High-Risk for Endarterectomy)
First randomized trial to evaluate the safety and efficacy of carotid artery stenting with emboli prevention in high surgical risk patients.
High risk criteria included prior carotid endarterectomy, neck surgery, radiation to the neck, occlusion of the contralateral carotids, congestive heart failure and other confounding medical problems.

POSTOPERATIVE MANAGEMENT

Many of the pharmacokinetic and pharmacodynamic intraoperative considerations apply to the postoperative care of the geriatric patient.

Postoperative considerations for the geriatric patients to minimize cognitive dysfunction:

- Avoid uncontrolled pain
- Avoid excessive sedatives and hypnotics
- Follow all the recommendations, as mentioned in the intraoperative care of the patient
- Make orientation efforts, for example:
    1. Address the patient by name
    2. Mention the time, day and the date
    3. Make sure clocks and calendars are available
- Maintain normal sleep-wake cycle (eliminating middle of the night vital signs measurements, and turning off lights in the nighttime)
- Avoid chemical and physical restraints
- Remove unnecessary bladder catheters and IV lines
- Ensure the use of patients' assistive devices (hearing aids, eyeglasses, walkers)
- Mobilize them as early as possible
- Avoid dehydration

Postoperative complications for ambulatory geriatric patients

In Ambulatory settings, the complications that hinder young patients' discharge to home (uncontrolled surgical pain, nausea and vomiting) are seldom the cause of unplanned hospital admission for the elderly. The common reasons for unanticipated hospital admissions are the cardio-pulmonary and neurological complications.

1. Cardiovascular Morbidities

Post anesthesia cardiovascular complications occur in 16.7% of elderly patients (over 80 years of age) compared to 2.6% in those less than 50 years of age. A high rate of cardiovascular complications (40%) was found in patients with preoperative heart disease, especially those with clinical signs of congestive heart failure, prior history of ischemic heart disease or previous myocardial infarction. The type of anesthesia does not appear to influence perioperative cardiovascular morbidity. Rather, perioperative hemodynamic control may be the key factor in minimizing cardiovascular morbidity.

2. Pulmonary Morbidities

Post anesthesia pulmonary complications develop in about 10% of elderly patients (over 80 years of age). A prior history of lung disease, congestive heart failure and neurological history increases the odds of an adverse postoperative pulmonary complication.

Preoperative optimization of respiratory function is important in decreasing adverse pulmonary events. Cessation of smoking at least for 24 hours prior to surgery is associated with better outcomes since carbon monoxide levels have been shown to decrease soon after cessation.

3. Neurological Morbidities

The incidence of postoperative cognitive deficit (POCD) is 25.8 % in the elderly patients one week after surgery and 9.9% three months after surgery. This was compared to a control group of hospitalized patients not undergoing surgery who had a POCD rate of 3.4% one week after hospitalization and 2.8% three months after hospitalization. Increasing age, a history of preoperative neurological disease, duration of anesthesia, lack of education, a second operation, postoperative infections and respiratory complications were identified as risk factors for early cognitive dysfunction. Several studies have looked at general versus regional anesthesia, and found no significant differences in the incidence of POCD.

Until more definitive clinical studies become available, minimizing the number of medications used, avoiding hypoxemia and hypercarbia, and providing adequate postoperative pain control appear to be the best approach in minimizing the occurrence of POCD in the geriatric surgical patient.

Postoperative management of cardiac surgical patients:

At the completion of the procedure these patients are transported still anesthetized and tracheally intubated to the Intensive Care Unit. While fast-tracking selected elderly patients has been successfully achieved in some institutions, rigid adherence to extubation protocols may be problematic in this age group and at times a slightly prolonged intubation may be necessary even in uncomplicated cases. Postoperative analgesia is usually achieved by administration of intravenous narcotics. While the idea of providing superior postoperative analgesia with a regional anesthetic such an epidural block before induction of general anesthesia is appealing, the wide application of this technique has been limited mainly because of logistical concerns. Moreover performing an epidural or even a spinal block in these patients with arthritic spines may be technically quite difficult.

Postoperative onset of atrial fibrillation is particularly common in the elderly, and may have significant hemodynamic consequences. The initiation of antiarrhythmic therapy, including cardioversion, and possibly anticoagulation may considerably prolong hospitalization. Given the conduction system abnormalities associated with age, placement of a permanent pacer may be necessary even after an uneventful postoperative course.

Postoperative delirium and neurocognitive dysfunction are common in the elderly, are multifactorial

in origin, can be difficult to treat and can have profound medical and socio-economic implications, with postoperative loss of independence and high rate of discharge to long-term care facilities.

Postoperative management of orthopedic surgical patients:

After having an uneventful intraoperative course, residents should be able to take care of the patients postoperatively by:

- Initiating postoperative pain management
  - Starts in the OR prior to transfer to PACU
  - Pain free patient in PACU is the happier patient
  - Don't undermine patient's concern about pain
  - Order postoperative pain medications
  - If patient has indwelling catheter, make sure continuous infusion is started
  - Use multi-modal therapy to optimize pain control

- Careful positioning and immobilization
  - Patient is maintained under anesthesia until desired immobilization is achieved like splint or cast
  - Limb is elevated to prevent dependant edema
  - If the patient received an upper Extremity block, arm is supported in the sling

- To diagnose early on and to take care of possible postoperative complications: Embolic Phenomenon
  - Fat Embolism: suspected in patients with long bone fracture who develop tachycardia, tachypnea and decreased end-tidal carbon dioxide pressure and arterial hypoxemia

  - Thromboembolism: DVT and pulmonary embolism is common after orthopedic surgery. Measures initiated in the OR and continued postoperatively by adding thromboembolic prophylactic medications as per ASRA guidelines

    Besides Thromboembolism, elderly orthopedic patients are prone to:
    1. Myocardial Ischemia
    2. Congestive Heart failure
    3. Arrhythmia: Atrial flutter and fibrillation
    4. Respiratory: Pneumonia and respiratory failure
    5. Renal Insufficiency
    6. Stroke
    7. Post operative cognitive dysfunction

Postoperative management of patients who underwent carotid artery surgery:

The objective is to perform a smooth and prompt emergence with optimal systemic and cerebral hemodynamics.

Potential complications are as follows:

Hypertension
Hypotension
Myocardial Infarction leading cause of death

Stroke, usually embolic
Intracranial hemorrhage
Reperfusion injury
Bleeding
Cranial nerve injury, occurs in 10% of patients
Vagus nerve injury (hoarseness)
Hypoglossal nerve injury (tongue deviation)

The most commonly injured nerves are the hypoglossal, vagus, recurrent, laryngeal, and accessory nerve.

IV. PRACTICE-BASED LEARNING AND IMPROVEMENT

- Use a systematic approach to learn from experience.
- Assimilates evidence based anesthesia/medical studies into their practice of anesthesia.
- Critically reviews literature.
- Uses information technology (on-line medical information) to support their education.
- Facilitates the learning of students and other health care professionals.
- Demonstrate awareness of and responsiveness to the larger context and system of health care, including the institution level.
- Appraise and utilize the various forms of information technology in day-to-day practice.
- Recognize the needs of different medical teams and other health care professional in patient care.
- Demonstrate a sensitivity to the needs of patients and society that supercedes self-interest.
- Demonstrate accountability to patients, society, and the profession.
- Demonstrate a commitment to excellence and on-going professional development.

V. INTERPERSONAL COMMUNICATION SKILLS

- Signs out on all patients admitted to the PACU
- Appropriately communicates with patient

Many elderly patients present with a sensory deficits (poor vision, hearing). Here are several actions, which may assist you in collecting data when sensory deficits exist:

- Face the patient
- Eliminate background noise and limit distractions
- Speak slowly and clearly
- Keep questions brief
- Provide privacy
- Delineate the effects of presbycusis on communication with the elderly. Speak slowly and clearly in the direct line of the patient's vision.
- Make sure hearing aids are available and in place, especially during regional anesthesia.
- Rephrase questions that are initially not understood. Do not use medical jargon. i.e., ambulate vs. walk.
- Refrain from use of open-ended questions.
- Elicit information initially from the patient and supplement history from others involved in the patient's care.

- Seeks help in a timely fashion and for appropriate situations (i.e. difficult airway)
- Documentation of all the procedures performed.
- Works effectively with others as a member or leader of a perioperative team.
- Elicit patient's medical history and obtain other pertinent information in an effective manner.
- Deliver concise, organized case presentations to the staff that include preanesthetic concerns and management.
- Exhibit polite language and behaviors in the workplace.
- Employ appropriate verbal, non-verbal and written communication skills with Attendings, Residents, OR Staff and PACU Nurses.
- Initiate interactions with patients, colleagues and peers using respectful communication and conscientious behaviors.

VI. SYSTEM-BASED PRACTICE

- Residents should recognize how their patient care affects other health care professionals and the health care organization, and how these elements of the system affect their own practice.
- Practices cost-effective health care and resource allocation that does not compromise quality of care.
- Residents must act as advocates for quality patient care.
- Knows how to partner with health care managers and health care providers to assess, coordinate, and improve health care and knows how these activities can affect system performance. (Team leader ability)
- Communicate with referring physicians.
- Justify and seek appropriate consultations with other subspecialty physicians.
- Arrange family meetings to discuss patient's condition, prognosis and treatment options.
- Address DNR/DNI and healthcare proxy issues.
- Describe the impact of a reduced social network with respect to the elderly.
- Making arrangements for Ambulatory geriatric patients with no social network. (see hospital guidelines)

EVALUATIONS

The residents' performance will be evaluated on all six core competency measures of ACGME. It will be based upon the daily evaluations of the Resident's clinical performance with verbal feedback from the faculty and quarterly by the Clinical Competency Committee. Sub-specialty evaluation of the Geriatric Orthopedic Anesthesiology Residents will be performed by the Director of Geriatric Orthopedic Anesthesia with input from other Geriatric Attending Anesthesiologists. A written evaluation is given to the Resident quarterly and the evaluations are discussed by the assigned preceptors.

SUMMARY

Through implementation of the GERIATRICC project at Maimonides Medical center, all the residents will gain experience in the competent management of uncomplicated and complex Geriatric surgical cases. Exposure will be based on their level of comfort and proficiency. They will learn to perform a specific technique of anesthesia- GA vs. Regional or combined based on risks and benefits of the procedure for that patient. During this rotation the residents will be performing pre and postoperative cognitive function assessments using the MiniCog and CAM testing methods. The residents will be actively involved in educating the other health team members regarding cognitive dysfunction in the elderly and introducing a multi-modal approach to manage these patients. These health care team members may include Nurse Practitioners in the Preadmission Testing area, staff nurses in the PACU and other postsurgical areas and other surgical staff. The residents will be provided with didactic lectures, and supplemental material to enhance their knowledge base and they will actively take part in preoperative conferences, and multidisciplinary case discussions.

After finishing three years of the residency training program, all the residents are expected to become clinically competent consultants. This will allow them to provide safe and compassionate anesthesia care and avoid perioperative complications for this set of the geriatric population.

Suggested Reading:

- Syllabus on Geriatric Anesthesiology http://www.asahq.org/clinical/geriatrics/syllabus.htm

- "Geriatric Anesthesiology"
  Jeffrey H. Silverstein, 2007

- "Anesthesia and Orthopaedic Surgery"
  André Boezaart, 2006

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