UNIVERSITY of CALIFORNIA
SAN DIEGO
MEDICAL CENTER

Anesthesia Preoperative Evaluation Syllabus

Beverly J. Newhouse, M.D.
Department of Anesthesiology
University of California, San Diego
2005

TABLE OF CONTENTS PAGE

WHY DO WE HAVE THE ANESTHESIA PREOPERATIVE EVALUATION?

Studies have shown that preoperative anesthesia evaluation has benefits for the patient, the anesthesiologist, the surgeons, and the hospital.[1]

1. For the patient:
   - reduce anxiety by offering personalized care/comfort
   - data has shown that preoperative evaluation by an anesthesiologist decreases the incidence of anxiety more effectively than pharmacologic anxiolysis[2,3]
   - here is where they can tell you about the TV show they saw on "awareness under anesthesia" and you can reassure them
   - answer questions
   - education regarding different types of anesthesia, options for post-op analgesia
   - discuss medications and which ones they should continue/discontinue preoperatively
   - data indicates that preoperative optimization of care can reduce post-op morbidity[4]

2. For the anesthesiologist:
   - learn of patient's medical conditions which might influence anesthetic management
   - devise an anesthetic plan *prior* to day of surgery
   - allow time to discuss medical conditions with consultants and/or order further testing

3. For the surgeons and hospital:
   - decrease the cost of perioperative care
   - improve the efficiency on day of surgery
   - decrease the number of cancellations and delays for surgery

Decrease in surgical cancellations for patients evaluated in the anesthesia preoperative evaluation clinic

Investigator	Decrease in Surgical Cancellations
Fischer[5]	88%
Pollard et al[6]	20%
Boothe[7]	60%
Macarthur et al[8]	5 times lower

WHAT SHOULD YOU ACCOMPLISH DURING THE PRE-OP VISIT?

History
Physical exam
Labs
ECG
Cardiac risk assessment and possible referral for further testing
Discussion of types of anesthesia applicable to surgical procedure
Discussion of risks/benefits/alternatives
Discussion of any invasive monitors likely to be placed on day of surgery
Instructions regarding medications
Discussion of options for post-op analgesia
Fasting and other instructions to patient
Answer questions
Follow-up any labs or further testing after patient visit

After seeing the patient, you should **document an anesthetic plan** on the pre-op form:

1. Consider the implications of patient co-morbidities -
    - Implications associated with cardiac disease, DM, HTN, asthma, and COPD are reviewed in this syllabus.
    - If you are unfamiliar with the anesthetic implications of a certain disease or disorder, you should look them up! Miller[9] and Barash[10] are the "gold standards" for anesthesia reference. A great source for information about uncommon diseases is Benumof's *Anesthesia and Uncommon Diseases*.[11] Jaffe's *Anesthesiologist's Manual of Surgical Procedures*[12] is an excellent reference about the surgical procedure, types of anesthesia applicable to the procedure, and associated anesthetic implications. And don't forget that you can always consult with colleagues.
2. Document all instructions given to patient.
3. Consider the need for premedication and/or prophylaxis for post-op N/V.
4. Consider the need for invasive monitoring.
5. Document the types of anesthesia discussed with the patient and patient preference.
6. Consider the options for post-op analgesia.

We will now elaborate on each of the components of the anesthesia preoperative evaluation……

HISTORY

As in other fields of medicine, it is important to obtain a thorough medical history from the patient, including past medical history, medications, allergies, social history, family history, and review of systems. In addition, history that is especially pertinent to perioperative care includes exercise tolerance, past experience with anesthesia, family history of problems with anesthesia, history of difficult intubation.

Use the pre-op anesthesia forms to guide your history, but in general the following points should be covered:

1. Type of surgical procedure and why (diagnosis)
2. HPI – symptoms a/w the surgical diagnosis that may impact anesthetic care
   - for example, in a patient undergoing cervical spine surgery, it is important to ask about range of motion of the neck and any positions that exacerbate pain (helps determine if an awake fiberoptic intubation may be necessary)
   - in a patient having hiatal hernia repair, it is important to ask about symptoms of GERD and severity (helps determine if RSI may be necessary)
3. PMH – other illnesses or medical conditions
   - exercise tolerance – important in later determining cardiac risk
4. PSH – include type of anesthetic and any problems/complications relating to the anesthetic or surgery, any known history of difficult airway, any eye surgeries (see note on "bubble in eye")*
   - specific complications related to anesthesia could include allergic reactions, prolonged skeletal muscle paralysis, delayed awakening, nausea/vomiting, hoarseness, sore throat, myalgia, post-spinal headache
4. Complete list of medications, including OTC and herbals
5. Complete list of allergies, including the type of reaction
6. Social history – tobacco, alcohol, drug use
7. Family history – focus on family history of problems with anesthesia, in particular MH or pseudocholinesterase deficiency

*Note on "Bubble in Eye":

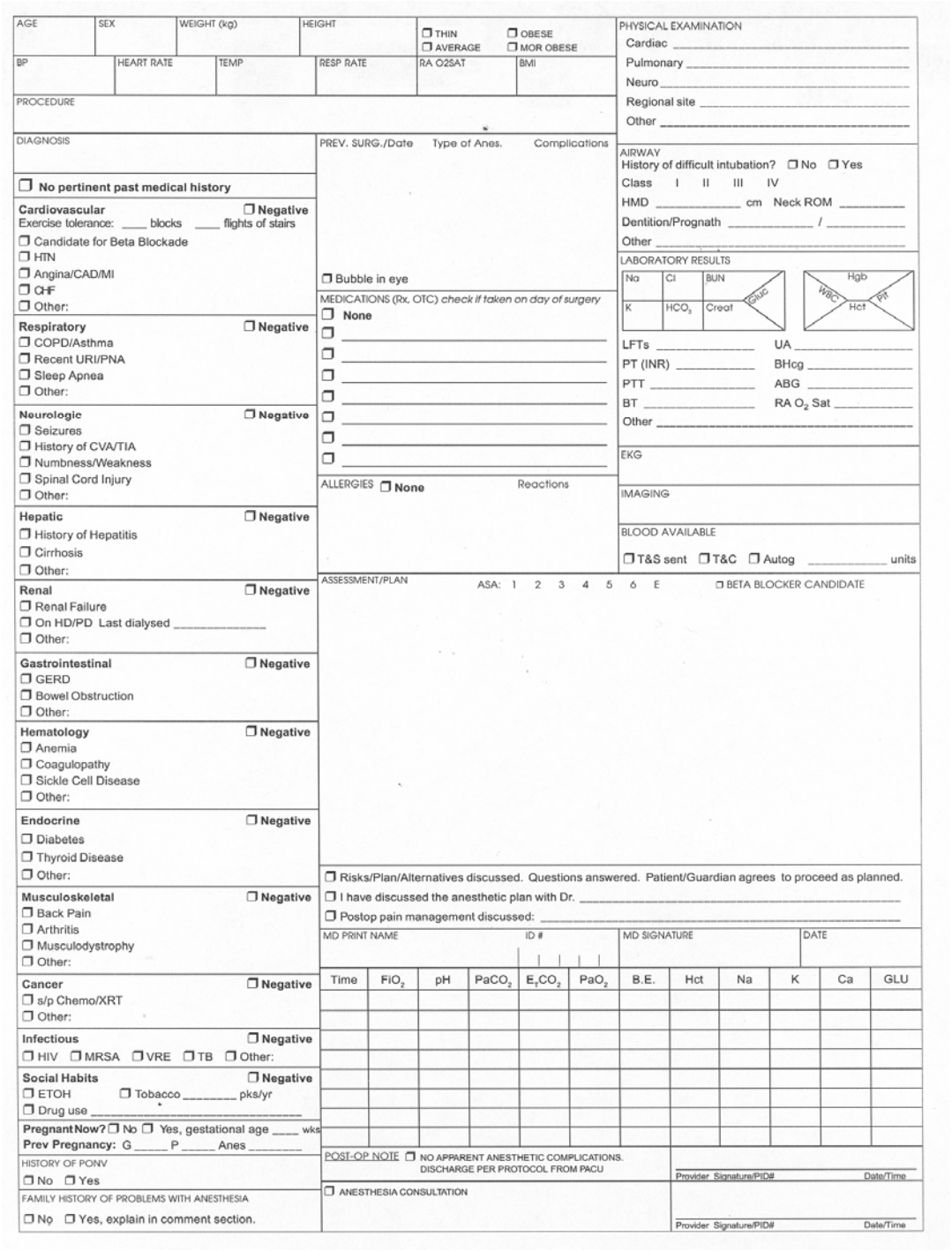
The UCSD pre-op form includes a box to check if the patient has a gas bubble in the eye. It is very important to ask patients (especially elderly) if they have had any eye surgeries and if yes, then do they have a BUBBLE IN THE EYE – most likely if they have had a vitrectomy or surgery for retinal detachment.

If so, you must document this and also write in large, legible print the words "DO NOT USE NITROUS OXIDE!" Nitrous oxide can expand an ocular gas bubble causing increased intraocular pressure and possible central retinal artery occlusion, which results in sudden blindness.[13]

Note on trauma patients:

It is important to note all injuries and results of diagnostic studies (i.e. head CT, C-spine films, CXR, FAST, CT abd/pelvis) as these may impact anesthetic management.

PREOPERATIVE RECORD AT UCSD



AGE | SEX | WEIGHT (kg) | HEIGHT | ❒ THIN ❒ AVERAGE ❒ OBESE ❒ MOR OBESE

BP | HEART RATE | TEMP | RESP RATE | RA O2SAT | BMI

PROCEDURE

DIAGNOSIS

PREV. SURG./Date Type of Anes. Complications

❒ No pertinent past medical history

Cardiovascular ❒ Negative
Exercise tolerance: ____ blocks ____ flights of stairs
❒ Candidate for Beta Blockade
❒ HTN
❒ Angina/CAD/MI
❒ CHF
❒ Other:

Respiratory ❒ Negative
❒ COPD/Asthma
❒ Recent URI/PNA
❒ Sleep Apnea
❒ Other:

Neurologic ❒ Negative
❒ Seizures
❒ History of CVA/TIA
❒ Numbness/Weakness
❒ Spinal Cord Injury
❒ Other:

Hepatic ❒ Negative
❒ History of Hepatitis
❒ Cirrhosis
❒ Other:

Renal ❒ Negative
❒ Renal Failure
❒ On HD/PD Last dialysed _____
❒ Other:

Gastrointestinal ❒ Negative
❒ GERD
❒ Bowel Obstruction
❒ Other:

Hematology ❒ Negative
❒ Anemia
❒ Coagulopathy
❒ Sickle Cell Disease
❒ Other:

Endocrine ❒ Negative
❒ Diabetes
❒ Thyroid Disease
❒ Other:

Musculoskeletal ❒ Negative
❒ Back Pain
❒ Arthritis
❒ Musculodystrophy
❒ Other:

Cancer ❒ Negative
❒ s/p Chemo/XRT
❒ Other:

Infectious ❒ Negative
❒ HIV ❒ MRSA ❒ VRE ❒ TB ❒ Other:

Social Habits ❒ Negative
❒ ETOH ❒ Tobacco _____ pks/yr
❒ Drug use _____

Pregnant Now? ❒ No ❒ Yes, gestational age ____ wks
Prev Pregnancy: G _____ P _____ Anes _____

HISTORY OF PONV
❒ No ❒ Yes

FAMILY HISTORY OF PROBLEMS WITH ANESTHESIA
❒ No ❒ Yes, explain in comment section.

❒ Bubble in eye

MEDICATIONS (Rx, OTC) *check if taken on day of surgery*
❒ None
❒ _____
❒ _____
❒ _____
❒ _____
❒ _____
❒ _____
❒ _____

ALLERGIES ❒ None Reactions

PHYSICAL EXAMINATION
Cardiac _____
Pulmonary _____
Neuro _____
Regional site _____
Other _____

AIRWAY
History of difficult intubation? ❒ No ❒ Yes
Class I II III IV
HMD _____ cm Neck ROM _____
Dentition/Prognath _____ / _____
Other _____

LABORATORY RESULTS
Na | Cl | BUN | Gluc
K | HCO_3 | Creat
Hgb | WBC | Hct | Plt
LFTs _____ UA _____
PT (INR) _____ BHcg _____
PTT _____ ABG _____
BT _____ RA O_2 Sat _____
Other _____

EKG

IMAGING

BLOOD AVAILABLE
❒ T&S sent ❒ T&C ❒ Autog _____ units

ASSESSMENT/PLAN ASA: 1 2 3 4 5 6 E ❒ BETA BLOCKER CANDIDATE

❒ Risks/Plan/Alternatives discussed. Questions answered. Patient/Guardian agrees to proceed as planned.
❒ I have discussed the anesthetic plan with Dr. _____
❒ Postop pain management discussed: _____

MD PRINT NAME ID # MD SIGNATURE DATE

Time	FiO_2	pH	$PaCO_2$	E_tCO_2	PaO_2	B.E.	Hct	Na	K	Ca	GLU

POST-OP NOTE ❒ NO APPARENT ANESTHETIC COMPLICATIONS. DISCHARGE PER PROTOCOL FROM PACU
Provider Signature/PID# Date/Time

❒ ANESTHESIA CONSULTATION
Provider Signature/PID# Date/Time

PREOPERATIVE RECORD AT VA HOSPITAL, LA JOLLA

PREANESTHETIC SUMMARY

SEX	AGE	WT (Kg)	HT	BP /	HR	TEMP	RR	Na	Cl	BUN	GLU	PT INR /

PROP OP _____ Date

DIAG

AIRWAY
CLASS_____
HMD_____ CM
NECK EXT _____
TEETH

❑ ADVISED OF DENTAL RISKS

CV
HTN
MI
ANGINA
CHF
LV FCN
EX TOL ❑ WNL

PUL
COPD
ASTHMA
SLEEP APNEA
TB ❑ WNL

NEUR
STROKE
SIEZURE
NEUROMUSC
Retinal Detachment/Bubble in Eye ❑ NEG

ENDOCRINE
DM
THYROID ❑ NEG

RENAL/HEPATIC
CRF
HEPATITIS ❑ NEG

OTHER
GE REFLUX
HIATAL HERNIA
BLEEDING
ANEST FHX
HIGH RISK
REGIONAL SITE ❑ NEG

ETOH DRUG ABUSE
❑ NEG ❑ NEG

SMOKING
ppd___ pyrs___
Year quit____
❑ Non-smoker

PROVIDER CONCERNS/ LABS OTHER TESTS TO BE ORDERED PRIOR TO SURGERY:

❑ THIS FORM HAS BEEN SCANNED INTO THE ELECTRONIC RECORD

PATIENT IDENTIFICATION:

ALLERGIES ❑ NKA

K	HCO_3	CR	Ca	PTT /
Hct	Hgb	PLTS	ABG: pH	O_2 Co_2

MEDS / VITAMINS / HERBALS

OTHER LAB

SAT_____%
ON_____FIO_2

CXR ❑ WNL

EKG ❑ WNL

SCANS

PRIOR ANESTHESIA

SURGERY	DATE	ANESTH	COMPLICATIONS

PRE-OP NOTE & ANESTHESIA PLAN ❑ VIA INTERPRETER

ASA STATUS: 1 2 3 4 5 6 E

❑ PROPOSED PROCEDURE, RX PLAN, RISKS AND ALTERNATIVES DISCUSSED. QUESTIONS ANSWERED. PT/SURROGATE AGREES TO PROCEED.
❑ PATIENT EDUCATION DONE, INCLUDING AWARENESS UNDER ANESTHESIA IF APPROPRIATE.
TRANSFUSION RISKS/BENEFITS/ALTERNATIVES DISCUSSED.
❑ ACCEPTED ❑ REFUSED ❑ N/A
❑ POST OP PAIN MANAGEMENT DISCUSSED. PLAN _____
❑ I HAVE DISCUSSED ANESTETIC PLAN WITH DR. _____

PRINT NAME	ID#	SIGNATURE	DATE

VA Form 10-62 (664) Revised: Sep 2005

PHYSICAL EXAM

The most important parts of the pre-anesthetic physical exam are:
1. Airway (see section on airway evaluation).
2. Cardiovascular – listen to the patient's heart, document any signs of CHF (edema, increased JVP, S3 gallop, etc.).
3. Pulmonary – observe the patient's work of breathing, listen for decreased breath sounds, wheezing, rales.

*These 3 systems should always be examined during the preoperative visit (and often are re-examined just before surgery).

Other areas of physical exam that may be important depending on the type of procedure or the patient's medical history include:

Neuro – at the very least, any focal deficits should be documented.
Vascular access – especially if invasive monitors will be necessary.
Regional site – note any sites of infection or distortion of anatomy.

AIRWAY EVALUATION

As you will learn from Dr. Benumof, there are 11 criteria for evaluating the patient's airway. The purpose of this evaluation is to predict and prepare for possible difficulty in managing the airway.

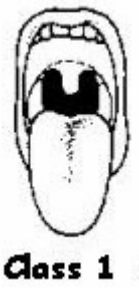
Criteria associated with possible difficult airway[14]:

1. Large protuberant incisors
2. Strong overbite (buck teeth)
3. Inability to prognath
4. Small inter-incisor distance (< 6cm)
5. Large tongue (Oropharyngeal or Mallampati classification)
6. Narrow or high-arched palate
7. Short thyromental distance (< 6cm)
   - including retrognathia or micrognathia
8. Excessive mandibular soft tissue
9. Short neck
10. Thick neck
11. Decreased range of motion of neck

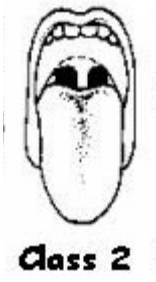
Inform the patient of the rare, but possible risk of dental injury during intubation. Ask about dentures/removable appliances and tell them they will have to remove them prior to induction.

Always document any loose, chipped, or missing teeth in pre-op note so that the anesthesiologist does not get blamed!

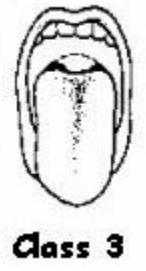
Mallampati Classification of Airway



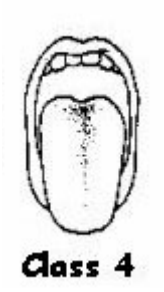
Tonsillar pillars, base of uvula, soft palate, hard palate, tongue visualized



Part of uvula, soft palate, hard palate, and tongue visualized



Only tongue, soft palate, and hard palate visualized



Only tongue and hard palate visualized

A history of a previous surgery performed w/o complications under GA reduces the probability of a major airway problem, but certainly does not eliminate it.

In addition to the 11 criteria, patients should also be questioned about a **history of sleep apnea.** Obstructive sleep apnea suggests periods of intermittent airway obstruction, which can be associated with difficult mask ventilation and/or difficult intubation.[9]

If you are concerned that the patient may have a difficult airway, you should discuss the possibility of an awake fiberoptic intubation.[15] Explain why this procedure may be necessary, emphasizing the importance of safely securing the airway before the patient stops breathing. Be sure to explain that we will use local anesthetic to topicalize the airway and likely provide some sedation before attempting to place the bronchoscope.

Aside from obvious indications, it will ultimately be the decision of the anesthesiologist present on the day of surgery as to whether an awake fiberoptic intubation is necessary, based on his/her airway evaluation.

There are many congenital syndromes that involve the airway and can lead to difficult mask ventilation and intubation. Examples include Down syndrome, Pierre Robin, Klippel-Feil, Treacher Collins, and Turner syndrome.[9] If you encounter a patient with one of these congenital syndromes, you should read about the specific airway implications and be prepared.

In addition, patients may present with other disorders that affect airway management, including traumatic, inflammatory, infectious, or neoplastic diseases. The table on the next page is adopted from Miller[9] and lists some examples along with their specific airway implications.

Selected pathologic states that may influence airway management[9]

Pathologic State	Concerns
Infectious epiglottitis	Laryngoscopy may worsen obstruction
Abscess (submandibular, retropharyngeal)	Distortion of airway makes mask ventilation (MV) or intubation difficult
Croup, bronchitis, pneumonia	Airway irritability increases risk of laryngospasm, bronchospasm
Papillomatosis	Airway obstruction
Tetanus	Trismus makes oral intubation impossible
Traumatic foreign body	Airway obstruction
Cervical spine injury	Neck manipulation may traumatize cord
Basilar skull fracture	Nasal intubation may result in intracranial tube placement
Maxillary/Mandibular injury	Airway obstruction, difficult MV
Laryngeal fracture	Partial obstruction may become complete with blind instrumentation; ETT may be misplaced outside larynx
Laryngeal edema	Irritable airway, narrowed inlet
Soft tissue injury (edema, bleeding)	Distortion of airway, obstruction
Neoplastic upper airway tumor (pharynx, larynx)	Inspiratory obstruction with spontaneous ventilation
Lower airway tumor (trachea, bronchi, mediastinum)	Lower airway distortion; airway obstruction may not be relieved by intubation
Radiation therapy	Fibrosis may distort airway
Inflammatory rheumatoid arthritis	Mandibular hypoplasia, TMJ arthritis, immobile cervical spine, laryngeal rotation
Ankylosing spondylitis	Fusion of cervical spine may make direct laryngoscopy impossible
Temporomandibular joint syndrome	Severe impairment of mouth opening
Scleroderma	Tight skin and TMJ involvement make mouth opening difficult
Angioedema	Obstructive swelling makes MV difficult
Sarcoidosis	Airway obstruction (lymphoid tissue)
Endocrine/Metabolic acromegaly	Large tongue, bony overgrowths
Diabetes mellitus	May have reduced mobility of altanto-occipital joint
Hypothyroidism	Large tongue, abnormal soft tissue can make MV and intubation difficult
Thyromegaly	Goiter may cause extrinsic compression or deviation
Obesity	Upper airway obstruction due to excess soft tissue makes MV difficult

LABS AND TESTING

Studies have shown that, in general, there is not much benefit from routine laboratory testing unless specifically indicated for a patient's medical condition.[16] Testing should be reserved for patients in whom the results may actually lead to improved care, change in management, or avoidance of a problem.

That being said, the invasiveness of the surgical procedure does influence the need for routine testing. Low-risk procedures generally require minimal or no routine testing.

Low-risk surgical procedures [Cardiac risk < 1%]	Endoscopic procedures Arthroscopic procedures Superficial procedures Cataract surgery Breast surgery
Intermediate-risk surgery [Cardiac risk < 5%]	Carotid endarterectomy Head and neck Intraperitoneal Intrathoracic Orthopedic Prostate
High-risk surgery [Cardiac risk can be > 5%]	Emergent major operations, particularly in the elderly Aortic and other major vascular Peripheral vascular Anticipated prolonged surgical procedures w/large fluid shifts and/or bld loss (e.g., major spine surgery, liver transplant)

From Eagle.[17]

In 2002 the ASA developed a preoperative testing advisory[1], which outlines the available studies and provides details regarding the value of different diagnostic tests.

Based on ASA advisory:

1. Healthy patients of any age undergoing a minimally invasive (low-risk) surgery do NOT require any routine labs.
2. Exception may be to obtain baseline Cr in any patient undergoing a procedure which will use IV contrast dye.
3. For intermediate-risk surgery, young healthy patients (age<65) again do NOT require routine labs.

4. For intermediate-risk surgery, testing *is* indicated for patients age>64 or with medical co-morbidities, i.e. chemistry panel in patients with DM or renal dz.
5. For high-risk surgery, <u>all</u> patients should have CBC and chemistry panel in addition to Type/Screen or Type/Cross. Other tests such as LFT's, coags are based on co-morbidities. However, at UCSD, most surgeons will go ahead and order LFT's and coags for these patients. Any patient on anticoagulant therapy will require coagulation studies after stopping therapy.
6. Routine pregnancy testing is NOT required for premenopausal women, BUT careful history regarding possible pregnancy *is* required and pregnancy test performed *if* indicated by history.
7. In general, the results of any test performed within the past 6 months are acceptable as long as the patient's medical condition has not changed significantly.
8. Preoperative CXR is usually only indicated for patients with a major known respiratory condition (i.e. COPD), *symptoms* of a respiratory condition or CHF, malignancy, or history of acute respiratory illness within the past 6 months. In addition, patients undergoing cardiothoracic surgery should have a CXR.
9. PFT's are rarely necessary – usually only if patient has severe COPD, SOB, orthopnea and will be undergoing a long surgery or intrathoracic surgery.
10. Urinalysis is usually only done for patients with symptoms of UTI or undergoing genito-urologic procedures.

The following chart is from Miller[9] and is intended as a guideline if you are not sure whether a particular patient may need certain lab studies:

Simplified strategy for preoperative and preprocedure testing based on co-morbid conditions

	CBC w/plt	**T/S & ALB**	**β-hCG**	**PT/PTT**	**Elec**	**BUN/Cr**	**Glu**	**AST/Alkp**	**ECG**	**CXR**	**UA**
Disease-based indications											
Alcohol abuse	x			x				x	x		
Adrenal cortical disease	x				x		x				
Anemia	x										
Cancer, except skin, without known metastases	x									x	
Diabetes					x	x	x		x		
Hematologic (significant)	x	x		x							

Simplified strategy for preoperative and preprocedure testing based on co-morbid conditions											
	CBC w/plt	**T/S & ALB**	**β-hCG**	**PT/PTT**	**Elec**	**BUN/Cr**	**Glu**	**AST/Alkp**	**ECG**	**CXR**	**UA**
abnormalities											
Exposure to hepatitis								x			
Hepatic disease				x		x		x			
Malignancy with chemotherapy	x			x		x		x	±	x	
Malnutrition	x	x		±	x						
Morbid obesity						x	x		x		
Peripheral vascular disease or stroke	x				x	x	x				
Personal or family history of bleeding	x			x				±			
Poor exercise tolerance or "Real Age" over 64	x					x	x				
Possibly pregnant			x								
Pulmonary disease	x								±	x	
Renal disease	x				x	x			x		
Rheumatoid arthritis	x								x	x	
Sleep apnea	x								x		
Smoking >40 pk-yr	x								x	x	
Suspected UTI or prosthesis insertion											x
Systemic Lupus						x			x	x	
Therapy-based indications											
Radiation therapy	x								x	x	
Use of anticoagulants	x			x							
Use of digoxin and diuretics					x	x			x		
Use of statins								x	x		
Use of steroids					x	x	x				

Simplified strategy for preoperative and preprocedure testing based on co-morbid conditions											
	CBC w/plt	**T/S & ALB**	**β-hCG**	**PT/PTT**	**Elec**	**BUN/Cr**	**Glu**	**AST/Alkp**	**ECG**	**CXR**	**UA**
Procedure-based indications											
Procedure with significant blood loss	x	x									
Procedure with radiographic dye						x					
Majorly invasive procedure	x	x			x	x					
‡For active, acute process only.											

Data from Roizen,[18] Kaplan et al,[19] and Biery et al.[20]

ECG

Any male over the age of 40 and any female over the age of 50 must have an ECG performed before receiving anesthesia.
In addition, any patient younger than these guidelines who has any clinical symptoms or signs of heart disease should have an ECG or any patient having cardiothoracic surgery.

You are not expected to be a cardiologist when evaluating the ECG, but you should be able to evaluate the following basic aspects:

1. Rate
2. Rhythm
3. Axis
4. Intervals
5. Conduction abnormalities
6. Hypertrophy
7. Evidence of ischemia/infarction

If you are not sure, consult an ECG text or ask a colleague for help. The appendix in Barash[10] includes some of the basics for reading an ECG.

CARDIAC RISK ASSESSMENT[17,21,22]

Why is cardiac risk assessment such a big deal?

Correct risk *stratification* is important so that appropriate measures can be taken to *reduce* the risk of perioperative MI. The perioperative period is associated with a hypercoagulable state and stress-induced release of catecholamines, factors which can exacerbate stress on the heart, leading to MI in patients with underlying CAD. According to some authors, the mortality rate is over 50% for patients who have a perioperative MI.[9]

Guidelines on perioperative cardiovascular evaluation for noncardiac surgery have been published by the ACC/AHA.[17] Using clinical risk factors, surgical risk factors, and exercise tolerance, it can be determined whether a patient will need further diagnostic cardiac testing prior to surgery. In general, invasive cardiac *intervention* prior to noncardiac surgery is reserved only for those patients who would have needed it anyway (independent of the noncardiac surgery). However, many patients can benefit from cardiac *risk reduction* using perioperative beta-blocker therapy. Studies have shown that the use of BB therapy in high-risk patients, particularly those with documented heart muscle at risk undergoing major vascular surgery, reduces perioperative risk and may eliminate the need for more invasive procedures.

Use the ACC/AHA flow chart to go through the stepwise process of assessing a patient's cardiac risk and the need for further testing prior to noncardiac surgery. The ACC/AHA guidelines use 5 factors to determine whether a patient should have further cardiac testing: (1) history and recency of coronary revascularization; (2) how long ago was the last *favorable* cardiac evaluation; (3) patient co-morbidities, classified as major, intermediate, or minor clinical predictors; (4) patient's functional status; and (5) low-, intermediate-, or high-risk surgery.

A couple of other important points:

1. Any patient with acute coronary syndrome (i.e. unstable angina or CHF exacerbation) is at high risk of developing further decompensation, ischemia, and possibly death during the perioperative period. These patients should undergo noncardiac surgery prior to cardiac intervention *only* in emergent circumstances.
2. According the ACC/AHA Task Force, of patients who have had an MI in the past, **those within 6 weeks of the MI are at the highest risk of re-infarction during the perioperative period. Therefore, elective surgery should be postponed at least 6 weeks after an MI.**
3. Most patients with known or suspected stable CAD can undergo noncardiac surgery with relative safety if they are treated with perioperative BB therapy.
4. Exercise tolerance is one of the strongest factors in determining cardiac risk. Patients with >4 METS functional capacity will NOT require any further cardiac testing. Patients who become symptomatic (i.e. chest pain, SOB) at <4 METS are

considered to have *poor* functional status and may need further cardiac testing. [The flow chart on p.19 lists examples of activities consistent with 1 MET, 4 METS, and >10 METS.]

5. Further cardiac testing should not be ordered unless the results will impact perioperative management.

How do beta-blockers and/or coronary revascularization prior to noncardiac surgery reduce perioperative risk?
The theory is that beta-blockers reduce demand on the heart, while revascularization improves supply in patients with critical stenoses.[23]

A few notes about aortic stenosis and valvular disease:

- According to Fleisher[21], "the presence of critical aortic stenosis has been associated with a prohibitive risk of undergoing elective noncardiac surgery. The presence of any of the classic triad of angina, syncope, and heart failure in a patient with aortic stenosis should alert the clinician to the need for further evaluation and potential interventions".
- According to Park[22], "patients who have severe AS can undergo indicated noncardiac surgery safely provided that the presence of severe AS is recognized and they receive intensive intraoperative and perioperative care with full knowledge of the implications of AS".
- According to John and Seiber[24], "because the elderly are at increased risk for significant valvular disease, the presence of a murmur on physical exam should prompt an echocardiographic evaluation to assess valvular pathology and cardiac function".

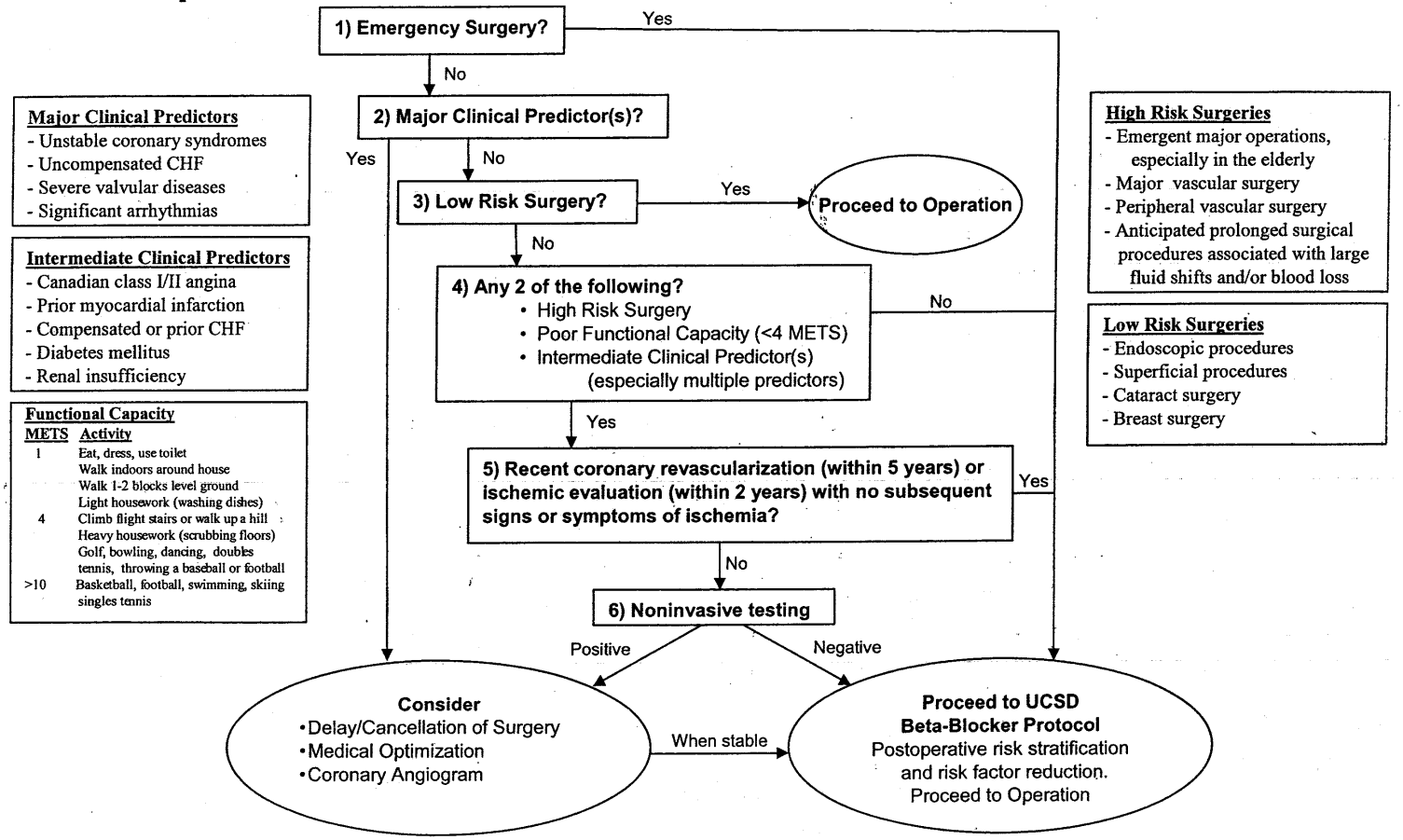
Note about conduction abnormalities:

- According to Jin and Cheung[25], "conduction abnormalities such as Mobitz 2-second degree heart block or complete third degree heart block should be treated with a pacemaker before elective procedures".

Note about patients with pacemakers:

- Try to get as much information as possible about the pacemaker because it will probably be necessary to contact the pacemaker representative on the day of surgery for reprogramming or interrogation.
- Information to obtain includes: [some patients will have an information card]
    - manufacturer (e.g., St. Jude, Medtronics, etc.), model and serial number
    - name of patient's cardiologist (may need to get all this information from MD)
    - mode of pacemaker (e.g., DDDR, VVI, etc.)
    - WHY the patient has a pacemaker (e.g., sick sinus syndrome, AV block, etc.)
    - What is the patient's underlying rhythm?

Simplified ACC/AHA Guideline for Stepwise Approach to Preoperative Cardiac Assessment for Noncardiac Surgery



"No test should be performed unless it is likely to influence patient management."

"It is almost never appropriate to recommend coronary bypass surgery or other invasive interventions such as coronary angioplasty in an effort to reduce the risk of noncardiac surgery, when they would not be otherwise indicated."

2002 ACC/AHA Guideline Update for Perioperative Cardiovascular Evaluation for Noncardiac Surgery

PERIOPERATIVE BETA-BLOCKER PROTOCOL

Step 1. Preoperative Cardiac Assessment (See Simplified ACC/AHA 2002 Guideline Flowsheet)

Step 2. Does patient qualify for perioperative beta-blocker use?

INCLUSION CRITERIA	EXCLUSION CRITERIA
☐ Known atherosclerotic vascular disease (coronary artery disease, atherosclerotic cerebrovascular disease, peripheral arterial disease) ***OR*** ☐ Diabetes mellitus ***OR*** ☐ Two or more of the following risk factors o Age > 65 years o Hypertension o Hyperlipidemia o Current smoking o Renal insufficiency or failure	☐ Known hypersensitivity, allergy, or intolerance to β-blocker ☐ Heart rate < 55 bpm or history of severe bradycardia with any AV slowing agent, without a pacemaker ☐ Sick sinus syndrome or advanced heart block without a pacemaker ☐ Uncompensated CHF ☐ *Poorly controlled* asthma or COPD (diagnosis of obstructive lung disease alone does not exclude β-blocker use) ☐ Minor surgery (e.g. cataract surgery, AV access, endoscopic procedures)

► If patient qualifies for inclusion, and there are no contraindications to beta-blocker use (see exclusion criteria above), proceed to Step 3.

► If patient has an absolute contraindication to beta-blocker use and has known atherosclerotic vascular disease or risk factors, consider use of clonidine as an alternative. (See Anesthesiology. 2004 Aug;101(2):284-93.)

Step 3. Instructions for beta-blocker initiation and titration

1. Start beta-blockade as early as possible when planning surgical intervention—as soon as cardiac risk is identified.
2. No data demonstrates the superiority of any one beta-1 specific agent over another. Initiation and titration guidelines for metoprolol are listed below. Avoid non-selective beta-blockers (e.g. propranolol) in patients with obstructive lung disease (asthma or COPD),
3. Use beta-blockers **WITH CAUTION** if patient currently on *calcium-channel blocking agents, digoxin, or antiarrhythmics.*
4. If the patient is beta-blocker *naïve* on admission to the hospital in a preoperative stay:
    a. Initiation of a beta-blocker should be po whenever possible
    b. Should po initiation of beta-blocker not be possible, initiation of IV beta-blocker by IV infusion or IVP may be allowed on *monitored* beds.
    c. Initiation with beta-blocker with IV infusion or IVP on unmonitored beds will NOT be allowed by the protocol; rather, the patient may have the beta-blocker initiated in the OR under the direction of anesthesiology.
5. *Target heart rate is 50 to 70 bpm*, with beta-blocker dosage titrated accordingly. There is no cardiovascular risk benefit to beta-blockade targeted to heart rate of 80 bpm.
6. Consider reversible causes of tachycardia at all stages of the perioperative setting (e.g. hypovolemia, blood loss, fever/infection, pain, etc.)
7. Beta-blockade should be continued through duration of hospitalization and preferably 30 days or more. Patients with known CAD or other cardiac conditions should be continued indefinitely.
8. Patients who meet criteria for perioperative beta blockers should have a post-operative follow-up appointment with their primary care provider or cardiologist within 1 to 2 weeks of hospital discharge.

OTHER COMMON DISEASES

Diabetes Mellitus (DM)

Diabetes mellitus is classified as insulin-dependent (IDDM) or non-insulin-dependent (NIDDM). Most of our patients fall into the NIDDM category, which is almost always associated with obesity as well.

The most serious acute complication of DM is ketoacidosis, but what we will see more commonly are manifestations of chronic DM related to macroangiopathies, microangiopathies, and neuropathies. These manifestations can have significant impact on patient management during the perioperative period.

Common problems associated with DM[9]:

- Hyperglycemia or hypoglycemia
- Autonomic neuropathy (including cardiac autonomic neuropathy and gastroparesis)
- Vascular disease (including CAD, cerebral vascular, and peripheral vascular disease)
- Renal disease
- Retinopathy
- Stiff joints
- Peripheral neuropathy

Things to assess during the preoperative evaluation:

1. Cardiac risk assessment and whether this patient should be on a beta-blocker – DM is an intermediate clinical predictor.
2. Evidence of other vascular disease (h/o claudication or CVA).
3. Renal dysfunction.
4. What is the usual range of patient's blood sugar measurements? If patient does not check, consider checking glycohemoglobin.
5. Limited joint mobility (including TMJ and cervical) – may affect airway management.
6. Peripheral neuropathy – increases risk of also having autonomic neuropathy and may affect regional anesthesia site.
7. Blood glucose and electrolytes should be checked preoperatively in any patient who will be having general anesthesia.
8. Discuss which medications the patient should discontinue preoperatively (see section on "Patient Medications").

A few key points about operative management of the diabetic patient:

1. Finger stick glucose should be checked on the morning of surgery in the pre-op area. Measurement of intraoperative glucose and electrolytes is indicated based on duration and magnitude of the surgery (definitely for long cases or surgeries associated with major fluid shifts).
2. The best way to avoid perioperative exacerbation of problems related to DM is to maintain proper glucose control and avoid dehydration and electrolyte disturbances. Frequent monitoring of glucose, volume status, acid/base status, and electrolytes guides therapy.
3. If the patient has peripheral sensory neuropathy, he/she is at higher risk of also having autonomic neuropathy.
4. Signs of cardiac autonomic neuropathy include orthostatic hypotension, resting tachycardia, and absent variation in heart rate with deep breathing. These patients have an increased risk of sudden death.[9] Sudden bradycardia and hypotension can occur during anesthesia → may be resistant to Atropine and Ephedrine and may require treatment with Epinephrine (10 mcg IV at a time).[26]
5. Another manifestation of autonomic neuropathy is gastroparesis which causes delayed emptying of solids and may increase the risk of aspiration on induction or emergence from anesthesia. Consider methods for decreasing aspiration risk.
6. Peripheral nerves in diabetics are more susceptible to compression injury so extra care should be taken in padding all pressure points.

Hypertension (HTN)

Essential hypertension is a risk factor for the development of CAD, CHF, renal dysfunction, and stroke. Medical therapy aimed at controlling hypertension reduces these risks. Long-standing uncontrolled hypertension leads to left ventricular hypertrophy (LVH), which causes diastolic ventricular dysfunction and also increases the heart's demand for oxygen. Patients who remain hypertensive before the induction of anesthesia are at increased risk for intraoperative hypotension and myocardial ischemia.[27]

Things to assess during the preoperative evaluation:

1. What range of blood pressures is normal for this patient? What is this patient's baseline BP? BP should be checked in the pre-op clinic and it may also be helpful to review the patient's chart to get an idea of baseline blood pressures. This will be important in determining the goal MAP to maintain intraoperatively.
2. If the patient's blood pressure is excessively high (i.e., >180/110), it may be necessary to refer the patient to primary care MD for medication management.
3. Evidence of end-organ dysfunction – history of CHF, CVA, renal dysfunction.
4. Cardiac risk assessment and whether this patient should be on a beta-blocker.
5. Discuss medications – in general, patients should continue anti-hypertensive medications throughout the perioperative period.
6. Discuss possibility of invasive monitoring (i.e., arterial line).

A few key points about operative management of the patient with hypertension:

1. It is common for patients with HTN to have exaggerated blood pressure responses intraoperatively. For example, the patient who is initially hypertensive may become hypotensive during induction of anesthesia. Anesthesia can "unmask" intravascular volume depletion due to chronic hypertension. Alternatively, the patient may become dramatically hypertensive during laryngoscopy or surgical stimulation. Be prepared for wide fluctuations and be ready to treat these responses.
2. Use 5-lead ECG for patients with HTN because there is a good chance they also have CAD.
3. The autoregulation curve for cerebral blood flow is shifted to the right in patients with chronic HTN; therefore, they are at increased risk of cerebral ischemia if perfusion pressure decreases. Keep MAP within 20-25% of baseline MAP.
4. During long or extensive surgeries or for patients with poorly controlled HTN, an arterial line is indicated and you should also consider the need for central venous monitoring +/- PAC.

Asthma

- More common in pediatric patients, but estimated to affect up to 10% of patients older than 55.[28]
- Chronic inflammatory changes in airway mucosa.
- Reversible obstruction to expiratory airflow.
- Airway hyperactivity and development of bronchospasm in response to stimuli.
- Clinical symptoms include wheezing and dyspnea.

Things to assess during preoperative evaluation:

1. How severe and frequent is the patient's asthma? Hospitalized recently? Required intubation? Required treatment with steroids?
2. How often does asthma occur and what triggers it?
3. What medications (inhalers) does patient use and how often?
4. Auscultate for wheezing.
5. Pre-op PFTs or ABG may be indicated in patient scheduled for thoracic or major abdominal operation.
6. Has the patient been on steroids recently and for how long? - may need stress dose steroids during surgery.
7. Instruct patient to bring inhalers on day of surgery.

A few key points about operative management of the patient with asthma:

1. Pre-op bronchodilator treatment may be helpful.

2. If possible, regional anesthesia may be better option for patient with severe asthma.
3. Goal during general anesthesia is to depress airway reflexes and avoid hyper-reactive bronchospasm in response to stimulation. Make sure the patient is "deep" enough before attempting intubation. Propofol and Ketamine are good induction agents. Can start volatile agent while still mask ventilating – Sevo and Iso are bronchodilators.
4. Treat intraoperative bronchospasm with beta-2 agonist and deepening of anesthesia with volatile agent. However, it is important to rule out other causes of increased pulmonary pressures such as mechanical obstruction, endobronchial intubation, and pulmonary aspiration.
5. If patient has recently been on steroids, consider stress-dose steroid administration during surgery, especially if patient has refractory hypotension.

Chronic obstructive pulmonary disease (COPD)

- Regional differences in airway resistance lead to areas of V/Q mismatch, which can lead to arterial hypoxemia.
- May retain carbon dioxide and develop respiratory acidosis.
- Clinical symptoms include dyspnea, wheezing, productive cough, increased work of breathing.
- Usually associated with history of cigarette smoking.
- Irreversible airway obstruction characterized by increased total lung capacity (TLC) and residual volume (RV), but decreased forced expiratory volume in 1 second (FEV1).
- Increased risk of postoperative respiratory failure.

Things to assess during preoperative evaluation:

1. Severity of disease - Use of inhalers and how often? Recent hospitalizations? Recent steroid use? Use of home oxygen?
2. Chest x-ray for evidence of pneumonia or bullae.
3. PFTs or ABG may be indicated depending on type of surgery and severity of disease.
4. Auscultate lungs.
5. Has the patient been on steroids recently – may need intraoperative stress-dose steroids.
6. Instruct patient to bring inhalers on day of surgery.

A few key points about operative management of the patient with COPD:

1. Preoperative bronchodilators.
2. Regional anesthesia may be better option.

3. Caution with nitrous oxide – can cause enlargement of bullae and lead to pneumothorax.
4. Important to humidify inspired gases to prevent drying of secretions.
5. Use smaller tidal volumes and longer time for exhalation (slow breathing rates, decreased I:E ratio).
6. If recent steroid use, consider intraoperative stress-dose steroid administration.

TYPES OF ANESTHESIA

When discussing the potential types of anesthesia that a patient may undergo, it is important to keep in mind the following:

1. Some surgical procedures may only be performed under general anesthesia while other procedures may be possible with a variety of anesthetic techniques.
2. The patient's medical history may strongly influence the type of anesthesia that should be offered.
3. The risks and benefits of various anesthetic techniques should be discussed with the patient.
4. Often it is possible to tailor anesthetic technique based on patient (or even surgeon) preference.
5. However, for safety reasons, the patient should understand that the ultimate decision regarding anesthetic technique will be made by the anesthesiologist present for the patient's surgery.
6. Many patients will not KNOW what kind of anesthesia they prefer (even after discussing it with you).

What should you tell patients about the different types of anesthesia performed at UCSD?

I. General anesthesia

- Most patients think of general as "going to sleep" or being "completely under".
- Patient should understand that under GA, they will have a breathing device (most likely an ETT or LMA) and they should be aware of the risk of dental injury.
- GA can be given via inhalational gases or IV meds – we often use a combination.
- Advantages: will not hear anything or remember anything, will be completely "under".
- Disadvantages: post-op nausea/vomiting, feeling "groggy" in PACU, requires control of airway, may have minor post-op sore throat, will require IV/PO meds for post-op analgesia.
- GA can be used for almost any type of surgical procedure; however, if the patient has a significant medical history (i.e. poor lung function), it may be prudent to go with an alternate form of anesthesia.

II. MAC = Monitored Anesthesia Care

- Minimally invasive procedures can be performed under MAC.

- MAC is usually combined with LOCAL anesthesia given by the surgeon or REGIONAL anesthesia given by you.
- Patients often think of MAC as "twilight sleep" or "conscious sedation".
- Explain to the patient that they will not be completely awake. They may even sleep throughout the surgical procedure, but it may be possible for them to hear or remember things from the surgery.
- They may feel the initial injection of LOCAL anesthesia.
- The major advantage over GA is that patient can spontaneously breathe and usually only requires a green O2 mask or nasal cannula.
- Another advantage is they may feel less "groggy" in PACU.
- Disadvantages: not good for long procedures because patient may become uncomfortable on OR table, not good when you need a secure airway.
- Examples of procedures which can be performed under MAC/LOCAL
    - Variety of eye procedures – i.e. cataract surgery
    - Cath lab procedures
    - Breast biopsy
    - Endoscopic procedures
    - Arthroscopic procedures

III. Regional anesthesia

Regional anesthesia uses local anesthetics to "numb" an area of the body. Three types of regional anesthesia are SPINAL, EPIDURAL, and PERIPHERAL NERVE BLOCKS.

Regional anesthesia is usually combined with MAC so that patients do not have to be completely awake during the surgery. On the other hand, the rare patient will *want* to be completely awake and therefore regional anesthesia takes care of pain control.

Spinal anesthesia:

- Local anesthetics and/or opioids are given as a single shot into the subarachnoid space.
- Takes effect quickly and blocks sensation in the lower body.
- Often used for rectal, bladder, prostate, gynecologic, and lower extremity procedures.
- Must know duration of surgery and make sure spinal will last longer than procedure.
- Advantages: patient can spontaneously ventilate, avoids PACU "grogginess", less post-op nausea/vomiting (but may have intra-op N/V if BP drops too much), avoids other complications associated with GA (oral trauma, aspiration), attenuates stress response; some studies have shown less blood loss, fewer thromboembolic complications, and improved LE graft patency.

- Disadvantages: not good for long procedures (>3 hrs unless an intrathecal catheter is placed), patient may hear or remember things from OR, sometimes technically difficult or impossible to perform, can get significant hypotension, possible pruritis if intrathecal opioids are used, possible urinary retention, small risk of high spinal may lead to bradycardia and/or respiratory difficulty necessitating conversion to GA.

Epidural anesthesia:

- Catheter is placed in the epidural space and is used for bolus or continuous dosing of local anesthetics and/or opioids.
- Can provide anesthesia for surgery on the lower body or analgesia in combination with GA
- Can be re-dosed if surgery lasts longer than expected.
- Main advantage is able to provide superior post-op analgesia.
- Advantages: patient can spontaneously ventilate (unless in combination w/ GA), less GA may be used, can re-bolus or use continuous infusion, less hypotension than spinal anesthesia.
- Disadvantages: risk of post-dural puncture headache, can be technically difficult in elderly patients or those with misalignment of back, sometimes doesn't work even if placed with proper technique due to patchy spread of local anesthetic.

Peripheral nerve blocks (PNBs):

- Local anesthetic injected in proximity to nerve(s) to provide numbness over surgical area.
- Upper extremity blocks often used for hand/wrist/shoulder procedures.
- Lower extremity blocks often used for foot/ankle/knee procedures.
- Usually used with MAC or GA but can be combined with a spinal or epidural.
- Can provide excellent post-op analgesia for up to 24 hours.
- Advantages: post-op analgesia, avoids or lessens amount of GA, patient can spontaneously ventilate (unless GA), reduces post-op nausea/vomiting.
- Disadvantages: requires experience, requires evaluation and supplementation which can take extra time, not good if patient cannot cooperate.
- Examples of PNBs: brachial plexus blocks (axillary, interscalene), IV regional anesthesia (Bier block), lumbar plexus block, sciatic nerve block, ankle block.

Before meeting with the patient, you should look up the surgical procedure in Jaffe[12] – that way you will know which kind of anesthetic techniques are appropriate to discuss with the patient.

CONSULT WITH REGIONAL ANESTHESIA FACULTY IF YOU HAVE QUESTIONS ABOUT THE APPROPRIATENESS OF REGIONAL FOR PARTICULAR PATIENTS OR SURGICAL PROCEDURES.

DISCUSSION OF ANESTHETIC RISKS

Patients will often ask the question "What are the risks of anesthesia?"

The answer to this question is complex because the risks are different for each patient based on co-morbidities, type of surgery, and of course, experience and vigilance of the anesthesiologist. The following information should give you an overall sense of what factors determine the risks of anesthesia and allow you to give patients a reasonable answer to the question. One thing is clear: **Data has demonstrated that risk directly attributable to anesthesia has declined over time and is rare.**[9]

Multiple studies have examined the factors associated with increased perioperative mortality and morbidity and have tried to pinpoint which factors may be attributable to anesthesia. Unfortunately it would be difficult to perform a randomized controlled trial on what anesthetic properties directly contribute to increased morbidity and mortality; therefore, the data that does exist is from retrospective studies.

A recurring factor in many of these studies is ASA Physical Status Classification:

ASA Status	Description
1	Normal healthy patient (independent of the planned surgery)
2	Mild systemic disease, but no functional limitations
3	Severe systemic disease that results in functional limitations
4	Severe systemic disease that is a constant threat to life
5	Critically ill patient not expected to survive without the surgery
6	Brain-dead patient whose organs are being harvested for donation
E	Any patient who needs an emergent operation

Many studies have supported the fact that major complications occur more frequently in patients with extensive co-morbidities (as characterized by ASA status). In addition, major complications tend to occur more frequently in elderly patients (possibly because they are more likely to have higher ASA status) and also in patients undergoing emergent procedures. **One study (Dripps et al.[29]) found that no deaths were attributable to anesthesia among 16,000 patients with ASA I physical status.**

Other examples of retrospective study results on anesthesia-related mortality:

Study investigators	Anesthesia-related mortality
Tikkanen and Hovi-Viander[30]	0.15 per 10,000 procedures
French survey[31]	1 in 185,000 procedures
Lagasse[32]	1 in 13,000 procedures

In these studies, the most common causes of death *attributable* to anesthesia included:

1. Equipment failure
2. Intubation complication
3. Pulmonary aspiration of gastric contents
4. Postoperative respiratory depression
5. Anaphylactic shock
6. Cardiac arrest
7. Medication error

Other common causes of death *not necessarily attributable* to anesthesia included:

1. Bronchopneumonia
2. CHF
3. MI
4. PE
5. Respiratory failure

The surgical procedure itself also significantly influences perioperative risk. Almost all of the studies have shown that emergency surgery is associated with additional risk. Next, cardiovascular surgery is associated with the highest risk, then major vascular surgery. Intrathoracic and abdominal procedures are associated with an intermediate risk.

Elderly patients are more likely to have co-morbidities and a decreased level of functioning. According to John and Seiber[24], "the best predictor of postoperative level of functioning is preoperative level of functioning." Studies have shown that inability to perform Activities of Daily Life (ADLs) independently and also weight loss > 10% within 6 months are risk factors for postoperative pneumonia in the elderly. In fact, these 2 risk factors may be more important than smoking and COPD.[24] Postoperative pneumonia carries a high 30-day mortality…..>20% in a study by Arozullah et al.[33]

Help patients to understand that the goal of the anesthesiologist is to reduce the risks related to their co-morbidities.

"Anesthesiologists must view perioperative organ protection as part of their goals to provide the highest quality of care and reduce perioperative risk."[21]

Ok, aside from mortality, what most patients *really* want to know are the <u>common</u> complications or "side effects" from anesthesia:

Common:

- Post-operative nausea and vomiting
- Waking up in pain

- Post-operative sore throat
- Confusion/grogginess upon awakening

Less common:

- Stress on the heart, including ischemia
- Heart arrhythmia
- Post-dural puncture headache associated with epidural/spinal anesthesia
- Bleeding or infection at site of regional anesthesia
- Nerve injury
- Dental injury
- Myalgias
- Allergy to anesthetic medication
- Postoperative respiratory distress
- Prolonged intubation and/or pulmonary complications (esp. if pt has underlying pulm dz), pulmonary aspiration

Rare:

- Awareness under anesthesia
- Anaphylactic reaction
- Local anesthetic toxicity
- Epidural hematoma or abscess
- CVA
- Organ failure
- Death

DISCUSSION OF ANY INVASIVE MONITORS

All patients will have at least 1 peripheral IV prior to induction of anesthesia (with the exception of pediatric patients undergoing inhalational induction).

Other invasive monitors and modes of access will be based on the patient's medical condition and the type of surgical procedure.

Jaffe[12] provides a good guideline about which procedures typically require invasive monitors. Also, patients with significant medical co-morbidities may require invasive monitors for induction of anesthesia, even if the surgical procedure is low-risk.

On the day of surgery, the anesthesiologist will ultimately decide and inform the patient if invasive monitors are necessary, but it is always a good idea to "forewarn" the patient during the preop visit if you suspect that invasive monitors will be necessary. Explaining *why* certain monitors may be necessary can expedite the process on the day of surgery.

Arterial line: allows beat-to-beat monitoring of blood pressure and provides access to obtain blood samples for analyses of ABG's and electrolytes. In general, A-lines offer low risk with high benefit in patients with co-morbidities such as cardiac disease or HTN. They are also helpful for surgical procedures with extensive fluid shifts, blood loss, or situations where frequent labs are required. The risk of arterial thrombosis is low if the catheter is continuously flushed with heparinized saline. Other complications include hematoma, bleeding, vasospasm, air embolism, nerve damage, infection, unintentional intra-arterial drug injection.[34]

Central venous catheter: allows continuous monitoring of volume status by central venous pressure (which parallels right heart pressures) and provides venous access for rapid infusion of fluids or infusion of drugs which may be toxic to peripheral veins. Complications associated with placement of a central line include carotid artery puncture/cannulation, pneumothorax, infection, air or thrombus embolism, hematoma, bleeding, trauma to the brachial plexus, and thoracic duct damage.[35]

PA catheter: allows continuous monitoring of pulmonary pressures, intermittent monitoring of pulmonary capillary wedge pressure (which parallels left heart pressures), thermodilution for estimation of cardiac output and calculation of other hemodynamic measures. Indications for the use of a PAC are controversial because complications can be severe or even fatal. Common indications include poor left ventricular function (EF < 40%), need for assessment of intravascular fluid volume or response to vasopressors, valvular heart disease, ARDS, massive shock or hemorrhage, and surgical procedures with an increased risk of complications from hemodynamic changes (i.e. cardiac or major vascular surgery). Risks include those associated with central line placement as well as cardiac dysrhythmias, heart block, pulmonary ischemia or infarction, pulmonary artery perforation, hemorrhage, bacteremia/endocarditis. The risk of complications increases with the duration of catheterization which should not exceed 72 hours.[36]

Examples of possible indications for PAC:
CAD w/ LV dysfunction or recent MI
Valvular heart dz, especially severe AS
Heart failure
Acute resp failure (i.e. ARDS)
Pulmonary HTN
Severe COPD
Complex fluid management – shock, trauma, ARF, acute burns, hemorrhagic pancreatitis
Specific surgical procedures – CABG, valve replacement, pericardiectomy, aortic cross-clamping (i.e. aortic aneurysm repair), sitting craniotomies, portal systemic shunts
High-risk obstetrics – severe toxemia, placental abruption

PATIENT MEDICATIONS

All medications should be reviewed and the patient should be instructed regarding continuing or discontinuing any meds during the perioperative period, including what to take on the morning of surgery. Although patients are NPO on the morning of surgery, they make take any necessary medications 2 hours before surgery with a small sip of water.

Some controversy exists about which medications should be discontinued perioperatively and for how long prior to surgery. In addition, there are few controlled trials regarding perioperative medication management, so decisions are often made based on past experience or manufacturer's recommendations.

Mercado and Petty[37] offer a nice review of the literature and provide recommendations based on available data (through 2003). The following are recommendations based on their review:

Cardiac drugs - in general, should be continued through the morning of surgery.

1. Beta-blockers should always be continued perioperatively. Observational studies have shown increased risk of perioperative MI and death in vascular patients whose BB's were discontinued.
2. Antiarrhythmics should be continued.
3. Digoxin should be continued and serum level should be checked preoperatively.
4. Antihypertensives should, in general, be continued. The exception to this is large doses of diuretics which can exacerbate hypovolemia and may be stopped on the morning of surgery (assuming the patient can tolerate stopping). Some authors argue that ACE inhibitors and ARBs may contribute to intraoperative hypotension, but the clinical significance of this is controversial. Clonidine should NOT be stopped because sudden cessation can lead to rebound hypertension.

Pulmonary drugs – in general, should be continued through the morning of surgery.

1. Inhaled agents, including beta agonists, anticholinergic agents, and steroids should be continued and the patient should *bring* inhalers so they may be used immediately prior to surgery.
2. Leukotriene inhibitors (Zafirlukast, Montelukast) and lipoxygenase inhibitors (Zileuton) should be continued.
3. Steroids should be continued and the patient may require a "stress" dose of Hydrocortisone intraoperatively.
4. Theophylline may be continued, but serum level should be checked preoperatively.

Diabetic agents

1. Insulin

    - patients should take their usual PM dose the night prior to surgery, then only take *one-third to one-half* their usual AM dose on the morning of surgery.
    - patients with an insulin pump should continue their *basal rate* only.
    - Finger-stick blood glucose should always be checked when the patient arrives and before induction of anesthesia.

2. Metformin – should be STOPPED 2 days prior to surgery (because of the rare associated lactic acidosis).
3. Other oral antiglycemics – should be STOPPED on the morning of surgery (because may lead to intraoperative hypoglycemia).

Antiplatelet agents and Anticoagulants

1. Aspirin – should be STOPPED 7 days preoperatively, especially in alcoholics (because they often have underlying platelet dysfunction).

    *There is one exception: occasionally, a cardiac patient will be told by the cardiologist to continue Aspirin perioperatively, in which case the patient should listen to the cardiologist.

2. Aggrenox – contains Aspirin, so should be STOPPED 7 days preoperatively unless told to continue by cardiologist.
3. Clopidogrel (Plavix) and Ticlopidine (Ticlid) – should be STOPPED 7 days preoperatively (both drugs *irreversibly* inhibit platelets).
4. Cilostazol (Pletal) – should be STOPPED 3 days prior to surgery (has a shorter half-life and causes *reversible* platelet inhibition).
5. NSAIDs (COX-1 and COX-2 inhibitors) – should be STOPPED 3 days prior to surgery (COX-1 because of reversible inhibition of platelet cyclooxygenase and COX-2 because of potential renal issues).
6. Warfarin – should be STOPPED 4-5 days preoperatively and the patient's INR should be checked prior to surgery.

Note: To avoid confusing our patients, we often just tell them to stop all of the above drugs 1 week prior to surgery.

7. Unfractionated heparin
    - *Therapeutic* doses of heparin should be HELD 12 hours prior to surgery.
    - *Prophylactic* doses (for DVT prophylaxis) can be continued unless the patient will be having regional (neuraxial) anesthesia.

8. Low molecular weight heparin – Lovenox (enoxaparin) and Fragmin (dalteparin)
    - In general, should be held 12-24 hours prior to surgery, but check with the primary team before instructing the patient.

Important note: Due to the risk of spinal hematoma, there are special guidelines for epidural catheter placement (and removal) in relation to anticoagulants, including the use of prophylactic doses of heparin and LMWH. See the next section of this syllabus.

Osteoporosis drugs

1. Raloxifene (Evista) – should be STOPPED at least 7 days prior to surgery (has been shown to increase the risk of perioperative DVT).
2. Estrogen (as used for Hormone Replacement Therapy) – also increases the risk of DVT; no data regarding how long it should be discontinued preoperatively (some authors have suggested 4 weeks); recommend telling patients to STOP at least 7 days preoperatively. Note: if used for contraception, see p.37 under "Endocrine agents".
3. Alendronate (Fosamax) – no guidelines, but is associated with GI side effects, so recommend stopping in the week prior to surgery.

Neurologic drugs

1. Anti-Parkinsonian agents – should be continued *through* the morning of surgery, but you should be aware of the possible interactions with anesthetic agents.
    - Return of Parkinsonian symptoms can develop even within hours of stopping carbidopa/levodopa (this is why we tell patients to continue through morning of surgery).
    - Prolonged cessation can cause "levodopa withdrawal syndrome" which is associated with symptoms similar to neuroleptic malignant syndrome.
    - You should be aware that carbidopa/levodopa *can* interact with anesthetic agents leading to the possibility of intraoperative arrhythmias.
    - You should also be aware that some anti-emetic agents (i.e., droperidol, metoclopramide) can cause adverse effects in patients with Parkinson's disease.
    - Selegiline is an MAOI occasionally used to treat Parkinson's disease and has been reported to cause a potentially fatal interaction with meperidine. If a patient is on selegiline, then meperidine should be strictly avoided perioperatively and other narcotics should be given with caution and close monitoring.
2. Antiseizure medications – should be continued through the morning of surgery.

- Be aware that many anti-epileptics have central depressant properties and may reduce the required doses of anesthetic agents (decrease MAC).
- Serum levels of phenytoin, carbamazepine, valproic acid should be checked preoperatively.

Psychiatric meds

1. Tricyclic antidepressants – may be continued. Be aware of anticholinergic side effects.
2. MAO inhibitors – should be STOPPED 2 weeks prior to surgery. In the case of urgent surgery, be extremely cautious with sympathomimetics, anticholinergics, and avoid meperidine (can develop life-threatening hypertensive crisis).
3. SSRIs – should be continued through the morning of surgery (discontinuation can lead to withdrawal symptoms).
4. Other antidepressants (venlafaxine, bupropion, mirtazapime, nefazodone) – may be continued (no known withdrawal syndrome or interaction with anesthetics).
5. Antipsychotics (phenothiazines and butyrophenones) – should be continued preoperatively (due to risk of withdrawal akinesia or rebound agitation). Be aware that they may enhance the effects of narcotics and barbiturates. Also may cause ECG abnormalities, including QT prolongation. Phenothiazines can decrease seizure threshold in susceptible patients.
6. Anxiolytics – benzodiazepines may be continued.
7. Lithium – may be continued preoperatively. Serum levels should be checked preoperatively. Be aware that Lithium can prolong the action of muscle relaxants.

Endocrine agents

1. Thyroid medications – should be continued through the morning of surgery. Thyroid studies should be performed preoperatively.
2. Steroids – may be continued. Any patient who has received steroids for more than 1 week in the several months prior to surgery should be considered for perioperative “stress” dose steroids to avoid adrenal insufficiency and hypotension.
3. Estrogen (oral contraceptives) – studies have shown that Estrogen increases the risk of thromboembolism perioperatively. That being said, the risks/benefits of perioperative DVT vs. perioperative pregnancy should be discussed with the patient. If the patient is willing to use alternative contraception, it may be wise to have her discontinue OCPs up to 1 month prior to surgery.

Rheumatologic drugs

1. Methotrexate – controversial. There have been concerns regarding wound healing and infectious complications, although no studies have supported these concerns. One study showed no problems and that it did not need to be discontinued perioperatively.
2. Leflunomide (immune modulator used to treat RA) – no known perioperative adverse effects, but no controlled trials. Can cause pancytopenia and hepatic dysfunction so labs should be checked preoperatively.

HIV drugs – antiretroviral drugs should be continued (because resistance can develop rapidly if doses are missed).

Viagra, Levitra, Cialis – should be STOPPED 3 days prior to surgery.

Herbal medications

- *Several* commonly used herbal agents have been associated with perioperative complications.
- Herbal medications are not regulated by the FDA and therefore may vary among different manufacturers.
- For these reasons, patients should be instructed to STOP all herbal medications at least 7 days prior to surgery.

Vitamins

- Multivitamins may be continued, but are not necessary.
- Vitamin E should be STOPPED a few days prior to surgery.

Antibiotics

- Be aware that aminoglycosides can potentiate neuromuscular blockers.

REGIONAL ANESTHESIA AND ANTICOAGULATION

Epidural (or spinal) hematoma can be a catastrophic consequence of neuraxial anesthesia and can lead to permanent neurological impairment including paralysis. In order to reduce the risk of spinal hematoma, the following recommendations have been published by the American Society of Regional Anesthesia (ASRA).[38]

*Note – the following recommendations assume that the patient is being treated with only one particular anticoagulant. Patients being treated with more than one agent concurrently may have increased risk of spinal hematoma.

Unfractionated IV Heparin

1. Discontinue IV Heparin at least 4 hours before and check aPTT to confirm normalization before performing neuraxial anesthesia.
2. After placement of neuraxial catheter, wait at least 1 hour before starting or re-dosing IV Heparin. This includes intra-operative IV Heparin (i.e. vascular procedures), which also should not be given until at least 1 hour after the neuraxial anesthesia was placed.
3. Wait at least 2-4 hours and check aPTT for normalization prior to *removing* a neuraxial catheter. Again, wait at least 1 hour before re-starting IV Heparin. The patient should have q 2hr neuro checks for at least 12 hours following catheter removal.

Prophylactic SQ Heparin

1. According the American Society of Regional Anesthesia, there is no contraindication to neuraxial anesthesia in a patient receiving SQ Heparin. They do recommend delaying the next dose of SQ Heparin until after the block is placed.
2. The German Society of Anesthesiology and Intensive Care Medicine recommends waiting 4 hours before neuraxial anesthesia and not re-dosing SQ Heparin for 1 hour after placement *or* removal of the catheter.
3. Patients who have been receiving SQ Heparin for more than 4 days should have their platelet count checked prior to neuraxial block or catheter removal (due to the risk of heparin-induced thrombocytopenia).

Recommendations regarding intra-operative IV Heparin

1. Avoid neuraxial anesthesia in any patient known to have any type of coagulopathy.
2. Wait at least 1 hour after the placement of neuraxial anesthesia before administering IV Heparin. [Some authors even advocate placing epidural catheter the day before the surgery for patients who will receive systemic IV Heparin for cardiopulmonary bypass].

3. Use the smallest amount of Heparin for the shortest duration possible to achieve therapeutic goals.
4. If a traumatic tap occurs, individual risk-benefit assessment should be discussed with the surgeon as to whether to proceed with surgery or delay the case 24 hours. In the case of surgery involving cardiopulmonary bypass where the patient will be receiving high-dose systemic IV Heparin, the case *should* be delayed 24 hours.
5. Do not remove neuraxial catheters until normal coagulation is restored as evidenced by normalization of aPTT. Do not re-heparinize for at least 1 hour after catheter removal.
6. The patient's neurological function should be closely monitored post-operatively.

Low Molecular Weight Heparin (LMWH)

1. For patients being treated with *therapeutic* doses of LMWH, it should be discontinued at least 24 hours prior to neuraxial anesthesia.
2. For patients being treated with *thromboprophylactic* doses of LMWH, it should be discontinued at least 12 hours prior to neuraxial anesthesia.
3. If a patient will be receiving *twice* daily dosing of LMWH for thromboprophylaxis postoperatively, the first dose should not occur until at least 24 hours postoperatively. Any indwelling neuraxial catheter should be removed at least 2 hours before this first dose.
4. If a patient will be receiving *once* daily dosing of LMWH for thromboprophylaxis postoperatively, the first dose should not occur until at least 8 hours postoperatively. The second dose should not occur for 24 hours after the first dose. If a neuraxial catheter is not removed before the initiation of LMWH, wait at least 12 hours after the last dose before removing it. Wait at least 2 hours after catheter removal before administering the next dose of LMWH.

Oral Warfarin

1. Coumadin should be stopped ideally 4-5 days before *and* PT/INR should be checked prior to neuraxial anesthesia. The ½ life of Coumadin varies from 48-72 hours.
2. Neuraxial catheters should not be removed until INR < 1.5.

   *Note: even if INR < 1.5, hemostasis may not be normal. Normal hemostasis may not be present until INR is within normal limits.

Antiplatelet agents

1. NSAIDs alone do not significantly increase the risk of spinal hematoma, but in combination with other anticoagulant agents there have been reports of increased bleeding complications, including spinal hematoma.
2. Ticlopidine should be discontinued 14 days prior to neuraxial anesthesia.
3. Clopidogrel should be discontinued 7 days prior to neuraxial anesthesia.

4. GP IIb/IIIa inhibitors should be discontinued at least 48 hours prior to neuraxial anesthesia.

Thrombolytic therapy – there are no published studies regarding neuraxial anesthesia in patients receiving thrombolytic therapy, but there are a few case reports of spinal hematomas, from which recommendations are suggested.[39]

1. Thrombolytic therapy should not be started in a patient with a history of lumbar puncture, spinal or epidural anesthesia, or epidural steroid injection in the last 10 days. [Unfortunately, this may be out of our hands since we would not be the ones starting thrombolytic tx].
2. During a pre-op evaluation, ask the patient if he/she has received any fibrinolytic or thrombolytic drugs recently (i.e. for history of MI or CVA). If yes, then the patient should probably *not* receive neuraxial anesthesia. Data is not available on the length of time to wait for neuraxial anesthesia after discontinuation of thrombolytics.
3. In the situation where a patient receives neuraxial anesthesia and then unexpectedly gets started on thrombolytics, neuro checks should be performed every 2 hours until the thrombolytics are discontinued.
4. If a neuraxial catheter is in place when a patient is started on fibrinolytics, it is recommended to follow fibrinogen levels and wait until normal levels are achieved before removing the catheter (again, no data for this recommendation).
5. Bottom line – due to the risk of serious hemorrhagic events in patients who are *known* to have received or be receiving thrombolytic therapy, it is prudent to avoid neuraxial anesthesia.

PREMEDICATION

During the preoperative evaluation, you can get a sense of whether the patient may benefit from premedication. If you think a preoperative medication is indicated, you should document it as part of your anesthetic plan so that whoever actually does the case can consider your suggestion. In general, premedication will be given by the anesthesiologist on the day of surgery in the pre-op holding area. If you feel that premedication will be important prior to the anesthesiologist seeing the patient on the day of surgery, you can contact the primary surgery team and recommend that they order the medication.

What is premedication useful for?

1. Psychological preparation
    a. Anxiolysis – benzodiazepines most commonly used just prior to elective surgery for mild/moderate sedation and relief of anxiety.
    b. Amnesia – benzos can provide anterograde amnesia (e.g., can prevent patient from remembering rolling back to the OR) and some retrograde amnesia.
    c. Insomnia – occasionally, patients may need medication the night before surgery to relieve insomnia associated with anxiety (again, benzos can be used or other sedating medications).
2. Pain control
    a. Analgesia may be necessary for patients experiencing preoperative pain in the pre-op holding area.
    b. Premedication with opioids facilitates placement of invasive monitors prior to induction of anesthesia.
    c. Opioids also helpful prior to performing a regional anesthetic technique.
3. Antisialogogue effect
    a. If the patient requires an awake fiberoptic intubation, pretreatment with an anticholinergic agent helps reduce oropharyngeal secretions. [**Caution in patients with cardiac disease as anticholinergics increase heart rate**].
        i. Scopolamine provides antisialogogue effect *and* some sedation.
        ii. Glycopyrolate provides antisialogogue effect without sedation.
4. Aspiration precautions
    a. Consider in patients who have increased risk of pulmonary aspiration (parturients, morbid obesity, significant GERD, “full stomach”, diabetics with gastroparesis).
    b. H_2 antagonists – e.g., ranitidine - blocks histamine release from parietal cells, which decreases the secretion of acidic gastric fluid.
    c. Antacids – e.g., sodium citrate – increases the pH of gastric fluid already present in the stomach.
    d. Prokinetics – e.g., metoclopramide – stimulates gastric emptying.
5. Attenuation of sympathetic nervous system responses

   a. Inclusion of an opioid in the premedication (also known as “preemptive analgesia”) has been shown to decrease the likelihood that undesirable increases in heart rate will accompany surgical stimulation (or laryngoscopy) during administration of volatile anesthetics.[40]
   b. Beta-blockers – IV beta-blockers (e.g., metoprolol) may be titrated to decrease heart rate prior to the induction of anesthesia.
   c. Alpha-2 agonists – IV clonidine or dexmedetomidine can be used preoperatively to produce sedation and attenuate hypertension and tachycardia associated with catecholamine release.
6. Antibiotics
   a. Often given at the same time as other premedication to establish plasma concentration of the drug prior to surgical incision.

POST-OP PAIN CONTROL AND PROPHYLAXIS FOR NAUSEA/VOMITING

Pain control

Studies have shown that perioperative pain is better tolerated if patients have been educated about the different modalities for treating pain. Discussing methods for post-op pain control also helps reassure patients that we view pain control as an important issue.

According to guidelines for acute pain management in the perioperative setting[41], a pain control plan should be included in the anesthetic preoperative evaluation.

Three techniques for perioperative pain control that have shown efficacy and safety are:

1. Epidural or intrathecal opioid analgesia
2. Intravenous PCA with systemic opioids
3. Regional analgesic technique (including continuous nerve block catheter)

At UCSD, the surgeons write the orders for postoperative pain control once the patient leaves the PACU. However it is appropriate and beneficial to discuss the above methods with the patient during the pre-op appointment, especially if the patient will be undergoing a particularly painful procedure and could benefit from an epidural or regional technique. The literature suggests that 2 routes of administration may provide more effective pain control than a single route, i.e. having an epidural PLUS getting IV opioids may be more effective than one or the other.[41]

Prophylaxis for post-operative nausea and vomiting (PONV)

Patients who experience PONV are frequently very dissatisfied with their surgical and anesthetic experience. Prophylaxis is not indicated for all patients because it increases cost and may lead to undesirable side effects. However, patients considered to be at increased risk of PONV may benefit from prophylactic treatment.

Patient characteristics associated with increased risk of PONV:

- Females, especially young, thin females and those currently menstruating[42]
- Patients with prior history of PONV or easy motion sickness
- Non-smokers

Anesthetic characteristics associated with increased risk of PONV:

- General anesthesia
- Increased duration of anesthesia
- Intraoperative use of opioids
- Use of nitrous oxide[43]

- IV Propofol-based anesthetic technique *decreases* risk of PONV[44,45]

Surgical characteristics associated with increased risk of PONV:

- Laparoscopic procedures
- Gynecologic procedures
- Ophthalmologic procedures, especially strabismus surgery
- Ear and nasal procedures
- Shoulder surgery[46]

Drug therapy for PONV prophylaxis:

1. Serotonin antagonists – e.g., ondansetron, dolasetron, granisetron
   - inhibition of 5-HT_3 receptors in the chemoreceptor trigger zone (CTZ)

2. Anti-histamines – e.g., diphenhydramine, dimenhydrinate
   - inhibition of H_1 receptors in the CTZ
   - also produce sedation

3. Anticholinergics – e.g., scopolamine
   - scopolamine patch applied prior to induction of anesthesia can help prevent PONV
   - inhibits muscarinic (M_1) and histamine (H_1) receptors in the hypothalamus and CTZ
   - also produces sedation

4. Butyrophenones – e.g., droperidol, metoclopramide
   - droperidol blocks dopamine receptors in the chemoreceptor trigger zone
   - caution with droperidol as it can prolong QT interval and cause increased sedation
   - metoclopramide promotes gastric motility, blocks dopamine receptors in the CTZ, and possesses weak antagonist properties for 5-HT_3 receptors

5. Phenothiazines – e.g., promethazine, prochlorperazine (antipsychotics)
   - block dopamine receptors in the chemoreceptor trigger zone
   - can produce sedation and extrapyramidal side effects

6. Steroids – e.g., dexamethasone
   - anti-emetic action not well understood; may inhibit prostaglandin or release endorphins[47]
   - most effective when administered prior to induction of anesthesia[48]

INSTRUCTIONS TO PATIENTS

1. Fasting instructions – see below
2. Medication instructions – as detailed earlier
3. Where and what time to arrive
4. What to bring – e.g., inhalers if asthmatic
5. What not to bring (or what they might want to leave with a family member prior to going to OR) – glasses, dentures, jewelry
6. Encourage smoking cessation prior to surgery[49]
7. Answer any other questions the patient or family has

Preoperative fasting instructions[50]

1. Patients should not have any solid foods or nonclear liquids for 6-8 hours prior to surgery.
2. Medications may be taken with a small sip of water up to 2 hours prior to surgery.
3. A *small* amount (i.e. few sips) of clear liquid is OK up to 2 hours prior to surgery. Coffee is considered a clear liquid as long as no cream or milk is added.
4. In practice, we tell our patients not to eat or drink anything after midnight and to take their AM medications 2 hours prior to surgery with a small sip of water.
5. For pediatric cases, no solid foods for 8 hours, formula okay up to 6 hours prior, breast milk okay up to 4 hours prior, and clear liquids okay up to 2 hours prior to surgery.[51]
6. Patients should understand that if these instructions are not followed, their surgery will be delayed or possibly cancelled. They should also understand the purpose of these guidelines – i.e. to reduce the risk of pulmonary aspiration.

REFERENCES

1. Practice advisory for preanesthesia evaluation: a report by the American Society of Anesthesiologists Task Force on preanesthesia evaluation. *Anesthesiology* Feb 2002;96(2).

2. Egbert LD, Battit GE, Turndorf H, et al. The value of the preoperative visit by an anesthetist. *JAMA* 1963:185.

3. Leigh JM, Walker J, Janaganthan P. Effect of preoperative anaesthetic visit on anxiety. *Br Med J* 1977:2.

4. Halaszynski TM, Juda R, Silverman DG. Optimizing postoperative outcomes with efficient preoperative assessment and management. *Crit Care Med* April 2004;32(4).

5. Fischer SP. Development and effectiveness of an anesthesia preoperative evaluation clinic in a teaching hospital. *Anesthesiology* 1996:85.

6. Pollard JB, Zboray AL, Mazze RI. Economic benefits attributed to opening a preoperative evaluation clinic for outpatients. *Anesth Analg* 1996:83.

7. Boothe P. Changing the admission process for elective surgery: an economic analysis. *Can J Anaesth* 1995:42.

8. Macarthur AJ, Macarthur C, Bevan JC. Preoperative assessment clinic reduces day surgery cancellations [abstract]. *Anesthesiology* 1991:75.

9. Miller RD, editor. *Miller's Anesthesia, 6th ed.* Elsevier Churchill Livingstone, 2005.

10. Barash PG, Cullen BF, Stoelting RK, editors. *Clinical Anesthesia, 4th ed.* Lippincott Williams & Wilkins, 2001.

11. Benumof, JL. *Anesthesia and Uncommon Diseases, 4th ed.* Saunders, 1998.

12. Jaffe RA, Samuels SI, editors. *Anesthesiologist's Manual of Surgical Procedures, 3rd ed.* Lippincott Williams & Wilkins, 2004.

13. Kodjikian L, Fleury J, Garweg J, et al. Blindness after nitrous oxide anesthesia and internal gas tamponade. *J Fr Ophtalmol.* 2003 Nov;26(9).

14. *Benumof's Airway Management: Principles and Practice, 2nd ed.* In: CA Hagberg (ed). Elsevier Science, Philadelphia, In Press, 2005.

15. Practice guidelines for management of the difficult airway: An updated report by the American Society of Anesthesiologists Task Force on management of the difficult airway. *Anesthesiology* May 2003;98(5).

16. Mantha S. Usefulness of routine preoperative testing: a prospective single-observer study. *J Clin Anesth* 2005 Feb;17(1).

17. Eagle KA. ACC/AHA Guideline update for perioperative cardiovascular evaluation for noncardiac surgery – executive summary. A report of the ACC/AHA Task Force on practice guidelines (committee to update the 1996 guidelines on perioperative cardiovascular evaluation for noncardiac surgery). *Anesth Analg* May 2002;94(5).

18. Roizen MF, Kaplan EB, Schreider BD, et al. The relative roles of the history and physical examination, and laboratory testing in preoperative evaluation for outpatient surgery: the "Starling" curve in preoperative laboratory testing. *Anesth Clin North Am* 1987:5.

19. Kaplan EB, Sheiner LB, Boeckmann AJ, et al. The usefulness of preoperative laboratory screening. *JAMA* 1985:253.

20. Biery C, Szatan M, Fourgeaux B, et al. Evaluation of a protocol for selective ordering of preoperative tests. *Lancet* 1986:1.

21. Fleisher LA. Preoperative cardiac evaluation. *Anesth Clin North Am* March 2004;22(1).

22. Park KW. Preoperative cardiac evaluation. *Anesth Clin North Am* June 2004;22(2).

23. Devereaux PJ, Leslie K, Yang H. The effect of perioperative beta-blockers on patients undergoing noncardiac surgery – is the answer in? *Can J Anaesth* 2004;51(8).

24. John AD, Sieber FE. Age-associated issues: geriatrics. *Anesth Clin North Am* March 2004;22(1).

25. Jin F, Chung F. Minimizing perioperative adverse events in the elderly. *Br J Anaesth* 2001;877(4):608-24.

26. Burgos LG, Ebert TJ, Asiddao C, et al. Increased intraoperative morbidity in diabetics with autonomic neuropathy. *Anesthesiology* 1989;70.

27. Prys-Roberts C. Anaesthesia and hypertension. *Br J Anaesth* 1984;334.

28. Georgitis JW. The 1997 asthama management guidelines and therapeutic issues relating to the treatment of asthma. *Chest* 1999;115.

29. Dripps RD, Lamont A, Echenhoff JE. The role of anesthesia in surgical mortality. *JAMA* 1961:178.

30. Tikkanen J, Hovi-Viander M. Death associated with anaesthesia and surgery in Finland in 1986 compared to 1975. *Acta Anaesthesiol Scand* 1995:39.

31. Tiret L, Desmonts JM, Hatton F, Vourc'h G. Complications associated with anaesthesia – a prospective survey in France. *Can Anaesth Soc J* 1986:33.

32. Lagasse RS. Anesthesia safety: model or myth? A review of the published literature and analysis of current original data. *Anesthesiology* 2002:97.

33. Arozullah AM, Khuri SF, Henderson WG, Daley J. Development and validation of multifactorial risk index for predicting postoperative pneumonia after major noncardiac surgery. *Ann Intern Med* 2001:135:847.

34. Scheer B, Perel A, Pfeiffer UJ: Clinical review: complications and risk factors of peripheral arterial catheters used for haemodynamic monitoring in anaesthesia and intensive care medicine. *Crit Care* 2002; 6(3).

35. Domino KB: Injuries and liability related to central vascular catheters: a closed claims analysis. *Anesthesiology* 2004; 100(6).

36. Practice guidelines for pulmonary artery catheterization: an updated report by the American Society of Anesthesiologists Task Force on pulmonary artery catheterization. *Anesthesiology* Oct 2003;99(4).

37. Mercado DL, Petty BG. Perioperative medication management. *Med Clin North Am* Jan 2003;87(1).

38. Horlocker TT, Wedel DJ, Benzon H, et al. Regional anesthesia in the anticoagulated patient: defining the risks (the second ASRA consensus conference on neuraxial anesthesia and anticoagulation). *Reg Anesth Pain Med* May-June 2003;28(3).

39. Weitz JI, Hirsh J, Samama MM. New anticoagulant drugs. The seventh ACCP conference on antithrombotic and thrombolytic therapy: evidence-based guidelines. *Chest* Sept 2004;126(3).

40. Cahalan MK, Lutz FW, Eger El II, et al. Narcotics decrease heart rate during inhalational anesthesia. *Anesth Analg* 1987;66.

41. Practice guidelines for acute pain management in the perioperative setting: An updated report by the American Society of Anesthesiologists Task Force on acute pain management. *Anesthesiology* June 2004;100(6).

42. Beattie WS, Lindbald T, Buckley DN, et al. Menstruation increases the risk of nausea and vomiting after laparoscopy. A prospective randomized study. *Anesthesiology* 1993;78.

43. Hartung J. Twenty-four of twenty-seven studies show a greater incidence of emesis associated with nitrous oxide. *Anesth Analg* 1996;83.

44. Borgeat A, Wilder-Smith OH, Saiah M, et al. Subhypnotic doses of propofol possess direct antiemetic properties. *Anesth Analg* 1992;74.

45. Ostman PL, Faure E, Glosten B, et al. Is the antiemetic effect of the emulsion formulation of propofol due to the lipid emulsion? *Anesth Analg* 1990;71.

46. Apfel CC, Laara E, Koivuranta M, et al. A simplified risk score for predicting postoperative nausea and vomiting: Conclusions from cross-validations between two centers. *Anesthesiology* 1999;91.

47. Golembiewski J, Chernin E, Chopra T. Prevention and treatment of postoperative nausea and vomiting. *Am J Health Syst Pharm* Jun 2005;62(12).

48. Wang JJ, Ho ST, Tzeng JJ et al. The effect of timing of dexamethasone administration on its efficacy as a prophylactic anti-emetic for postoperative nausea and vomiting. *Anesth Analg*. 2000; 91:136–9.

49. Farquhar D. Encouraging smoking cessation means fewer postoperative complications. *Can Med Assoc J* June 2002;166(12).

50. Warner MA, Caplan RA, Epstein BS, et al. Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures. Anesthesiology 1999;90.

51. Maxwell LG. Age-associated issues in preoperative evaluation, testing, and planning: pediatrics. *Anesth Clin North Am* March 2004;22(1).