Rational Selection of Preoperative Laboratory Examinations

What's needed now, what's next?

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Disclosures

No financial disclosures relevant to this topic

Objectives:

As a result of our discussion today, you will be able to:

- Describe appropriate, patient-specific screening tests needed before surgery and anesthesia
- Provide evidence-guided input to systems of preanesthesia screening regarding indicated testing and evaluation methods
- Understand the potential application of evolving technology to preanesthesia evaluation
First chance to respond this morning: background information

Where do you practice?
1. Teaching hospital
2. Private practice hospital
3. Offices and other places

Next Background check

How would you best describe your practice setting?
1. Care team: academic setting
2. Care team: other than academic setting
3. Just you in the room

Why discuss this anyway?
• Why do lab testing?
• What is point of preanesthesia evaluation?
• Where does imperative to do this arise?
What do lab results do for your patient?

- Our hopes:
  - Find out if patient is “OK” for surgery
  - Improve our ability to predict complications
  - Protect us from harm / liability claims
- Our goal: Provide safe perioperative care: testing should help us provide safe perioperative care

Understanding relative risks

How much risk does anesthesia subject you to?

1. Similar to climbing mountains
2. Similar to flying in a commercial airplane
3. Similar to running a nuclear power plant
4. Similar to driving on the freeway

Background

- Anesthesiology has been in the forefront of improving patient safety
- Culminating in the founding of the Anesthesia Patient Safety Foundation in 1984
- Many in our field have been involved with redesigning equipment, monitors, medications and care systems to improve patient safety
Declining anesthesia risk

- Extracted data from death certificates in 2 intervals (1978-1982, 1996-1999), reviewed by Medical Certifiers (response rate, 97%), and the anesthesiologist in charge (acceptance rate, 97%)
- Death rate 1999 per 100,000
  - Totally related to anesthesia: 0.69
  - Partially related to anesthesia: 4 - 7

Risk prediction


To understand how to improve, need to know where we are:

- Risk of death from anesthesia
  - 1950s: estimated at about 1 in 2,000 anesthetics
  - 1980s: estimated about 1 in 10,000 anesthetics
- More recent estimates of risk of mortality caused by anesthesia
  - Range: 1:300,000, up to 1:1,000,000
- Steady improvement in overall perioperative safety
- Mortality rates for older & sicker (ASA 4 and 5) patients remain much higher than for ASA 1 patients.
  - Lagasse RS: Anesthesiology 2002; 97:1609-17
  - Lienhart: Anesthesiology 2006; 105:1087-97
Comparing risky events

- Healthy patients: “safer” than driving
- Sick patients, heart surgery: not much better than climbing Mt. Everest


Reporting complications

- Standard data collection and reporting methods probably under-report morbidity
- Hutter evaluated Mass General Hospital M&M reports
- Compared to data reported to national databank

Factors contributing to perioperative risk

- Human error contributes to adverse outcome
- Often evaluated to be avoidable
- Related to surgery and anesthesia
  - Some deaths could potentially be avoided by more extended use of airway algorithms, thorough preoperative evaluation, training, education, and use of protocols for diagnosis and treatment
Factors contributing to perioperative risk

- System (collection of people and processes) errors contribute to periop morbidity
- Heine: Journal of Surgical Oncology 2004;88:1431-52
- To minimize errors in perioperative care, systems need to:
  - Assure appropriate individual intelligence
  - Provide continuing education
  - Facilitate efficient teamwork AND communication
  - Develop "culture of safety" that involves ALL individuals and systems involved in periop care
- Despite progress, anesthesia-related causes of M&M are still reported to occur

Assessment:

- The risk of dying from anesthesia is low for healthy patients
- Older, sicker patients are still at significant risk for perioperative death; some of this risk is related to anesthesia factors
- Further improvement in patient safety in the perioperative period will require a combination of personal, systems-based and technological efforts
- The patient population presenting for anesthesia continues to shift to higher age, at the same time we are being "asked" to decrease cost per patient while improving "value" (cost/outcome, assuming same or better outcomes)
- We have to manage perioperative risk!
- We have to have a wise approach to selecting who needs what for preanesthesia evaluation

Why order tests before anesthesia?

- CMS Conditions of Participation, Interpretive Guidelines §482.51(b) [emphasis added]
  - Policies governing surgical care should contain:
    - Aseptic and sterile surveillance and practice, including scrub techniques;
    - Identification of infected and non-infected cases;
    - Housekeeping requirements/procedures
    - Patient care requirements:
      - Preoperative work-up;
      - Patient consents and releases
      - Clinical procedures;
      - Safety practices
      - Patient identification procedures; …
  - Policies and procedures must be written, implemented and enforced. Surgical services’ policies must be in accordance with acceptable standards of medical practice and surgical patient care.
CMS COP: preanesthesia assessment

- §482.52(b)(1) - A pre-anesthesia evaluation completed and documented by an individual qualified to administer anesthesia, as specified in paragraph (a) of this section, performed within 48 hours prior to surgery or a procedure requiring anesthesia services.
- Interpretive Guidelines §482.52(b)(1)
  - The pre-anesthesia evaluation must be performed within 48 hours prior to any inpatient or outpatient surgery or procedure requiring anesthesia services. As a minimum, the pre-operative anesthetic evaluation of the patient should include:
    - Notation of anesthesia risk,
    - Anesthesia, drug and allergy history,
    - Any potential anesthesia problems identified,
    - Patient's condition prior to induction of anesthesia.

- Note the absence of required lab/other tests except as part of anesthesia risk assessment, identification of possible anesthesia problems.

California Code of Regulations

- TITLE 22. Social Security; Division 5. Licensing and Certification of Health Facilities, Home Health Agencies, Clinics, and Referral Agencies; Chapter 1. General Acute Care Hospitals; Article 3. Basic Services;
- §70223. Surgical Service General Requirements:
  - (d) Prior to commencing surgery the person responsible for administering anesthesia, or the surgeon if a general anesthetic is not to be administered, shall verify the patient's identity, the site and side of the body to be operated on, and ascertain that a record of the following appears in the patient's medical record:
    - (1) An interval medical history and physical examination performed and recorded within the previous 24 hours.
    - (2) Appropriate screening tests, based on the needs of the patient, accomplished and recorded within 72 hours prior to surgery.
    - (3) An informed consent, in writing, for the contemplated surgical procedure.
  - (e) The requirements of (d), above, do not preclude rendering emergency medical or surgical care to a patient in dire circumstances.

Medical Staff Governance

- Medical Staff Policies and Procedures or Rules and Regulations may mandate testing prior to surgery or anesthesia.
- Many of these are based on local consensus.
- Some of these may be past their “best-by date”...
Practice Advisory for Preanesthesia Evaluation

A Report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation

- Practice advisories are systematically developed reports that are intended to assist decision-making in areas of patient care where scientific evidence is insufficient to develop an evidence-based model.
- These are made by a combination of literature review and expert opinion
- Not the same as standards or practice guidelines: evidence base is not as strong for advisories
- "Advisories are not intended as guidelines, standards, or absolute requirements."
- Advisories are recommendations that should be considered when formulating local practices, and you should expect to revise them as practices evolve.

What is preanesthesia evaluation?

- PAE is the evaluation of information of importance to the patient's care
  - Medical records
  - H&P
  - Medical testing
  - Consultation
- Value of PAE:
  - Educate the patient
  - Organize resources needed for safe care
  - Plan for perioperative care including anesthesia induction/maintenance, recovery and pain control

How is preanesthesia evaluation done in your practice?

In addition to mandated pre-anesthesia assessment that always occurs prior to taking the patient into the operating room for a procedure, when is the PAE done?

1. Morning of surgery, before going to OR
2. Phone call night before, made by me
3. Phone call before surgery, made by someone else (RN or NP)
4. In a formal pre-anesthesia clinic, some time before surgery
What does this patient need?

57 year old with long-standing hypertension, smoking, overweight and recent renal failure, scheduled for case with general anesthesia

1. Panel: CBC, PT, PTT, chemistry (6 or 7), ECG, CXR
2. Just potassium
3. Nothing
4. Don’t know enough yet to answer

• If you chose #4, what else do you need to know before you answer?
• Does this patient need a cardiac evaluation?

Who should get Cardiac Evaluation?

• Scheduled for cardiac surgery: of course
• Others: ACC / AHA guidelines

Grading Evidence from Literature

• Class of indication: best Class I to worst Class III (shouldn’t be done)
• Levels of evidence:
  • A: “Best” evidence
    ▫ Multiple populations evaluated
    ▫ Data from multiple RCT or meta-analyses
  • B:
    ▫ Limited populations studied
    ▫ Data from only 1 RCT or from nonrandomized studies
  • C:
    ▫ Very limited populations evaluated
    ▫ Only consensus expert opinion, case studies or standard of care
“Best Evidence”

- Class 1: Benefit >> Risk
- Procedure, treatment, test SHOULD BE performed/given
- Level A:
  - Should be done or is indicated since shown as useful / effective
  - Evidence from multiple RCT or meta-analyses
- Level B: recommended based on evidence
- Level C: is usually effective or beneficial

Other Evidence

- Class IIa: Benefit >> Risk:
  - Reasonable to do, since it can be useful or effective; "probably indicated"
  - More studies with focused objectives could move these to Class I
  - Some conflicting evidence may be in literature from several RCT or meta-analyses
  - Class IIb: Benefit ≥ Risk:
    - May consider these, but more data is needed
    - Often conflicting reports in literature
  - Class III: Risk ≥ Benefit
    - Don’t do this: it is not helpful, may be harmful
    - Not recommended

So who needs cardiac testing?

- Class I recommendations ("should be done")
  - Emergency noncardiac surgery: don’t need testing since they need to have their surgical emergency taken care of (Level C)
  - Active cardiac conditions: evaluate and treat prior to OR (Level B)
  - Significant coronary anomalies
    - Should be treated or repaired
    - Revascularization/valve surgery
  - Significant arrhythmias
    - High-grade atrioventricular block, Mobitz II atrioventricular block, third-degree atrioventricular block
    - Symptomatic ventricular arrhythmias, supraventricular arrhythmias (including atrial fibrillation) with in ventricular heart rate (heart rate >150 bpm ventricular), symptomatic bradycardia, newly diagnosed ventricular arrhythmias
  - Severe aortic stenosis
    - Mean pressure gradient >40 mm Hg, aortic valve area <1.0 cm², or symptoms
  - Severe aortic insufficiency (prognostic grades are severe, maximal pressure gradient >40 mm Hg, or symptoms)
  - High-risk patients (e.g., patients with advanced heart disease, congestive heart failure, or prior myocardial infarction with LV ejection fraction <30%)

  These patients are NOT REALLY candidates for elective surgery
More Class I recommendations

- "Low Risk" surgery: go to OR without testing (Level B)
  - Remember definition: < 1% risk for cardiac death or nonfatal MI
- Poor functional status (< 4 METS) BUT no symptoms AND no RCRI risk factors: Go To OR

Preop Cardiac Testing recommendations

- Class Ia (Level B): "Probably indicated"
  - Functional class ≥ 4 METS: go to surgery
  - < 4 METS or unknown AND ≥ 3 RCRI factors AND scheduled vascular surgery: More Testing IF it will change management
  - < 4 METS or unknown AND ≥ 3 RCRI factors AND scheduled intermediate risk surgery: Go To OR and control heart rate
  - < 4 METS or unknown AND 1 or 2 RCRI factors AND scheduled vascular or intermediate risk surgery: Go To OR and control heart rate

Preop Cardiac Testing Recommendations

- Class IIb (Level B): "consider these" based on functional status:
  - < 4 METS or unknown AND ≥ 1 RCRI factors AND scheduled intermediate risk surgery: CONSIDER noninvasive testing IF results will change management
  - < 4 METS or unknown AND 1 or 2 RCRI factors AND scheduled vascular or intermediate risk surgery: CONSIDER noninvasive testing IF results will change management
Revised Cardiac Risk Index

- Lee et al: Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. Circulation. 1999 Sep 7;100(10):1043-9
- Six clinical predictors of complications following nonurgent major noncardiac surgery:
  - High-risk surgery
  - History of ischemic heart disease
  - History of compensated or prior HF
  - History of cerebrovascular disease
  - Diabetes mellitus
  - Renal insufficiency
- Risk for major complications goes up as the number of these factors present increases

What does this patient need?

67 year old with long-standing hypertension, ex-smoker, BMI 37, scheduled for hip replacement surgery with general anesthesia.
1. Panel: CBC, PT, PTT, chemistry (6 or 7), ECG, CXR
2. Just potassium
3. Nothing
4. Don’t know enough yet to answer

FUNCTIONAL STATUS MATTERS!

What’s a MET?

- One metabolic equivalent (MET) is a unit of sitting/resting oxygen uptake (3.5 mL of O2 per kilogram of body weight per minute)
- Loose correlation with symptoms
what does this patient need?

87 year old female scheduled for surgery. She has a past history of "stable" cardiac disease, saw her Cardiologist 5 years ago. Other medical problems include the indication for surgery, hypertension and arthritis.

1. Panel: CBC, PT, PTT, chemistry (6 or 7), ECG, CXR
2. Just echo
3. Nothing
4. Don’t know enough yet to answer
What else matters?

Type of procedure!

How to categorize surgical risk

- J Am Coll Cardiol. 2009 Nov 24;54(22):e13-e18
- Cardiac risk stratification based on combined risk for cardiac death and nonfatal myocardial infarction

Vascular risk often >5% in reports

<table>
<thead>
<tr>
<th>Type of procedure</th>
<th>Cardiac death and nonfatal myocardial infarction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head and neck surgery</td>
<td>Aortic and major vascular surgery</td>
</tr>
<tr>
<td>Orthopedic surgery</td>
<td>Peripheral vascular surgery</td>
</tr>
<tr>
<td>Prostate surgery</td>
<td>Intraperitoneal and intrathoracic surgery</td>
</tr>
<tr>
<td>Endoscopic procedures</td>
<td>Carotid endarterectomy</td>
</tr>
<tr>
<td>Intermediate risk between 1% and 5%</td>
<td></td>
</tr>
<tr>
<td>Low risk usually &lt;1%</td>
<td></td>
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<tr>
<td>Cataract surgery</td>
<td></td>
</tr>
<tr>
<td>Breast surgery</td>
<td></td>
</tr>
<tr>
<td>Ambulatory surgery</td>
<td></td>
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</tbody>
</table>

P-POSSUM definitions

- Scoring system developed for surgical audit
- Risk is related to surgical severity:

<table>
<thead>
<tr>
<th>Score</th>
<th>Minor</th>
<th>Intermediate</th>
<th>Major</th>
<th>Major +</th>
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<tbody>
<tr>
<td>0-1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>&gt;4</td>
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<tr>
<td>Blood loss per operation, mL</td>
<td>&lt;100</td>
<td>101-500</td>
<td>501-999</td>
<td>&gt;1000</td>
</tr>
<tr>
<td>Peritoneal contamination</td>
<td>No</td>
<td>Local contamination</td>
<td>Free intraabdominal contamination</td>
<td>Peritonitis</td>
</tr>
<tr>
<td>Presence of malignancy</td>
<td>No</td>
<td>Primary cancer only</td>
<td>Node metastases</td>
<td>Distant metastases</td>
</tr>
<tr>
<td>Timing of operation</td>
<td>Elective</td>
<td>Emergency - immediate, operation &lt;2h</td>
<td>Emergency - possible, operation &lt;24h</td>
<td>Emergency - urgent, operation &lt;24h</td>
</tr>
</tbody>
</table>

Anesthesiology, Loma Linda University School of Medicine
Hopkins Pasternak surgical risk categories


- **Surgical Category 1**: Minimal risk to the patient independent of anesthesia, these are minimally invasive procedures with little or no blood loss, and may often be done in the office with scheduling in OR just for anesthesia/monitoring
  - Examples include: breast biopsy, removal of minor skin or subcutaneous lesions, myringotomy tubes, hysteroscopy, cystoscopy, vasectomy, circumcision, and fiberoptic bronchoscopy
  - **EXCLUDES**: open exposure of internal body organs, repair of vascular or neurologic structures, placement of prosthetic devices, entry into abdomen, thorax, neck, cranium, or extremities, postoperative monitored care setting (ICU, ACU), open exposure of abdomen, thorax, neck, cranium, resection of major body organs

- **Surgical Category 2**: Minimal to moderately invasive procedure, with blood loss less than 500 ml, these present mild risk to patient independent of anesthesia
  - Examples include: diagnostic laparoscopy, D&C, Fallopian tubal ligation, arthroscopy, inguinal hernia repair, laparoscopic abdominal procedures such as lysis of adhesions, fundoplication and cholecystectomy; tonsillectomy, adenoidectomy, umbilical hernia repair, septo-rhino-plexy, percutaneous lung biopsy, extensive superficial procedures, dialysis fistula creation, vein stripping
  - **EXCLUDES**: open exposure of internal body organs, repair of vascular or neurologic structures, placement of prosthetic devices, postoperative monitored care, major vascular repair (e.g., aortofemoral bypass), planned postoperative monitored care setting (ICU, ACU)

- **Surgical Category 3**: Moderately to significantly invasive procedure, with blood loss potential of 500–1,500 ml, these procedures present moderate risk to patient independent of anesthesia.
  - Examples include: thyroidectomy, hysterectomy, myomectomy, cystectomy, open cholecystectomy, laminectomy, hip/knee replacement, nephrectomy, major laparoscopic procedures, resection and reconstructive surgery of the digestive tract
  - **EXCLUDES**: open thoracic or intracranial procedure, major procedure on the oropharynx, major vascular, skeletal, neurologic repair
**Hopkins Pasternak surgical risk 4**

- Surgical Category 4: Highly invasive procedures, with anticipated blood loss greater than 1,500 ml, these present a major risk to patient independent of anesthesia
- Examples include: major orthopedic-spinal reconstruction, major reconstruction of the gastrointestinal tract, major genitourinary surgery (e.g., radical retropubic prostatectomy), and major vascular repair without postoperative ICU stays

**Hopkins Pasternak surgical risk 5**

- Surgical Category 5: Highly invasive procedures with anticipated blood loss greater than 1,500 ml, these present a critical risk to patient independent of anesthesia. Usual postoperative ICU stays with invasive monitoring.
- Examples include: cardiothoracic procedures, intracranial procedures, liver transplantation, major vascular-, orthopedic or neurosurgery

**How are lab tests ordered/chosen?**

In your practice, how does a patient end up getting tests done before anesthesia?

1. Hospital / OR policy specifies a "panel" for all surgical patients
2. Surgeons pick what they feel is indicated
3. Anesthesia Department provides guidelines for appropriate tests for individual patients
4. Referring doctors / healthcare system sends us what they approve, won’t pay for any other tests
Generalized reasons to order medical tests

- The result will confirm or refute a suspected important diagnosis
- The result will change management or risk stratification
- You intend to evaluate / act on the result

- Don’t order an investigation otherwise

How does testing fit into PAE?

- From the ASA Practice Advisory:
  - Criteria for Anesthesia Intervention, Testing, and Consultation:
    - Any evaluations, tests, and consultations required for a patient are done with the reasonable expectation that such activities will result in benefits that exceed the potential adverse effects.
    - Potential benefits may include a change in the content or timing of anesthetic management or perioperative resource utilization that may improve the safety and effectiveness of anesthetic processes involved with perioperative care.
    - Potential adverse effects may include interventions that result in injury, discomfort, inconvenience, delays, or costs that are not commensurate with the anticipated benefits.

ASA Basic Standards for Preanesthesia Care [emphasis added]

- An anesthesiologist shall be responsible for determining the medical status of the patient and developing a plan of anesthesia care.
- The anesthesiologist, before the delivery of anesthesia care, is responsible for:
  - Reviewing the available medical record.
  - Interviewing and performing a focused examination of the patient to:
    - Discuss the medical history, including previous anesthetic experiences and medical therapy.
    - Assess those aspects of the patient’s physical condition that might affect decisions regarding perioperative risk and management.
  - Ordering and reviewing pertinent available tests and consultations as necessary for the delivery of anesthesia care.
  - Ordering appropriate preoperative medications.
  - Ensuring that consent has been obtained for the anesthesia care.
  - Documenting in the chart that the above has been performed.
So what tests do we “always” need?

STATEMENT ON ROUTINE PREOPERATIVE LABORATORY
AND DIAGNOSTIC SCREENING
Committee of Origin, Standards and Practice Parameters
(Approved by the ASA House of Delegates on October 15, 2003, and last amended on October 22, 2008)

- Preamesthesia testing makes sense when you need to:
  - Discover or identify a suspected disease
  - Verify status of a known disease
  - Plan management of patients with disease as they go through perioperative experience

ASA Statement on Routine Testing

- "No routine* laboratory or diagnostic screening† test is necessary for the preanesthetic evaluation of patients. Appropriate indications for ordering tests include the identification of specific clinical indicators or risk factors (e.g., age, pre-existing disease, magnitude of the surgical procedure)."
- Routine is defined as ordering tests without a clinical indication
- Screening means efforts to detect disease in unselected populations of asymptomatic patients

What is a good lab test?

- High Sensitivity / High Specificity
  - Sensitivity: how good is the test’s ability to detect a condition
    - Will the test find all the patients who have the condition?
    - Example: Hematocrit will detect anemia (although the abnormal level may differ between practices)
  - Specificity: how good is the tests’ ability to identify those without the condition
    - Will the test be NEGATIVE in those who really don’t have the condition
    - Example: Hematocrit above your chosen abnormal will of course be negative for anemia

- So what?
  - Too sensitive may label normals as abnormal
  - Too specific may miss abnormalities
  - By lab definitions, up to 5% of “normals” will have test results outside “normal range”, so some will have “abnormal” results BUT not actually have a disease state
True and false negative and positive

- Essentially NO clinically useful test is 100% sensitive AND ALSO 100% specific
- This gives rise to possible misleading results
- One way to evaluate the utility of a test is to look at:
  - True positives: test says you DO have the condition and you actually DO
  - True negatives: test says you DON’T have the condition and you actually DON’T
  - False positives: test says you DO have the condition BUT you actually DON’T
  - False negatives: test says you DON’T have the condition BUT you actually DO

Why you care

- False positives:
  - If the test is for a significant condition, additional resources are spent tracking down the disease
  - Patient may be given incorrect label for other purposes (pre-existing medical conditions for insurance, fitness for duty / employment)
- False negatives:
  - If the test is for a significant condition, treatment may be delayed
  - Contacts, family, societal impacts?

Receiver Operating Characteristic Curves

- Plots sensitivity against (1 – specificity)
- Demonstrates true positive vs true negative of a test
- Provides both a graphical representation and a numeric area under the ROC curve to allow comparison between tests
- "Perfect" test would have area under ROC = 1; graph would be up y-axis from (0,0) to (0,1) the horizontal parallel to x-axis along y = 1
- A random test (coin toss) would have an area under the ROC curve = 0.5
- Most tests are not "perfect"
Comparison of ROC curves

- Analysis of 11 point airway exam performed by CA1 trainees as predictor of difficult airway management:
  - Area under ROC curve = 0.643

- Analysis of 11 point airway exam performed by Staff anesthesiologists as predictor of difficult airway management:
  - Area under ROC curve = 0.877

But who gets which tests?

1. All patients scheduled for elective surgery needs preanesthesia labs / tests
2. Nobody scheduled for elective surgery needs preanesthesia labs / tests
3. The referring healthcare system approves and orders any tests my patient is allowed to get
4. Don’t need to know; my surgeons make those decisions for me

Routine Testing?

ASA Statement on Routine Testing

- "Individual anesthesiologists should order test(s) when, in their judgment, the results may influence decisions regarding risks and management of the anesthesia and surgery"
- "Legal requirements for laboratory testing where they exist should be observed"
- "The results of tests relevant to anesthetic management should be reviewed prior to initiation of the anesthetic"
- "Relevant abnormalities should be noted and action taken, if appropriate"
Another General Rule of Testing

Since you are much more likely to find a positive result in a patient who has the condition the test screens for, order tests based on what you believe the patient has. In other words: obtain history **BEFORE** you order tests.

Can we safely skip routine testing?

Look at the literature

Cataract surgery: evidence from the literature

- Systematic review of literature: 3 RCT including 21,531 cataract subjects
  - Routine testing: 10,764
  - No Testing: 10,767
- 707 medical adverse events: 3 deaths, 61 hospital admissions, other (mostly cardiovascular) events
  - Pretesting group: 353
  - No Testing group: 354
Cataracts: does testing decrease cancellations?

- No difference in cancellation rate in pretesting or no testing patients
- Costs were evaluated in one of the three studies: 2.55 times higher
- Authors’ conclusions:
  - "This review has shown that routine pre-operative testing does not increase the safety of cataract surgery.
  - Alternatives to routine preoperative medical testing have been proposed, including self-administered health questionnaires, which could substitute for health provider histories and physical examinations.
  - Such avenues may lead to cost-effective means of identifying those at increased risk of medical adverse events due to cataract surgery.
  - However, despite the rare occurrence, adverse medical events precipitated by cataract surgery remain a concern because of the large number of elderly patients with multiple medical comorbidities who have cataract surgery in various settings.
  - The studies summarized in this review should assist recommendations for the standard of care of cataract surgery, at least in developed settings."

Routine testing: routine benefit?

<table>
<thead>
<tr>
<th>Lab Test</th>
<th>Prevalence ASA &gt; 2</th>
<th>Predictive value ASA &gt; 2</th>
<th>Odds Ratio</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin</td>
<td>6.9%</td>
<td>15.7%</td>
<td>1.69</td>
<td>0.10</td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.5%</td>
<td>18.3%</td>
<td>2.86</td>
<td>0.002</td>
</tr>
<tr>
<td>Low Na</td>
<td>0</td>
<td>1.3%</td>
<td>1.58</td>
<td>0.70</td>
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<tr>
<td>High Na</td>
<td>0.6%</td>
<td>1.7%</td>
<td>13.11</td>
<td>0.02</td>
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<tr>
<td>Low K</td>
<td>2.9%</td>
<td>6.6%</td>
<td>1.74</td>
<td>0.24</td>
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<tr>
<td>High K</td>
<td>2.3%</td>
<td>6.3%</td>
<td>0.89</td>
<td>0.84</td>
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<tr>
<td>Glucose</td>
<td>4.4%</td>
<td>8.4%</td>
<td>1.53</td>
<td>0.44</td>
</tr>
<tr>
<td>PLT</td>
<td>1.3%</td>
<td>2.6%</td>
<td>1.65</td>
<td>0.47</td>
</tr>
<tr>
<td>ASA &gt; 2</td>
<td>3.48</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>1.05</td>
<td>0.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgical risk</td>
<td>4.16</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Indicated testing

- Michota, Frost: The preoperative evaluation: Use the history and physical rather than routine testing. Cleveland Clinic J Med 2004; 71: 63-70
  - Routine testing is less valuable than a well-done history and examination
  - "Most abnormalities in laboratory values can be predicted from the patient’s history and findings of the physical examination"
  - "Abnormalities discovered on laboratory testing often do not lead to changes in perioperative care"
  - Recommendation: order tests justified by a specific sign, symptom or diagnosis based on H&P
How good are the screening tests we order?

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECG</td>
<td>.27</td>
<td>.81</td>
</tr>
<tr>
<td>Stress test</td>
<td>.64</td>
<td>.91</td>
</tr>
<tr>
<td>PTT</td>
<td>.99</td>
<td>.72</td>
</tr>
<tr>
<td>Glucose tolerance</td>
<td>.76</td>
<td>.56</td>
</tr>
<tr>
<td>Liver enzymes</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Blood pregnancy test</td>
<td>.98</td>
<td>.99</td>
</tr>
<tr>
<td>UA/C</td>
<td>.95</td>
<td>.84</td>
</tr>
<tr>
<td>HCT</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>PLT count</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>


Guidance “value”

<table>
<thead>
<tr>
<th>Test</th>
<th>Not indicated</th>
<th>Abnormal</th>
<th>Abnormal, not indicated</th>
<th>Abnormal, not indicated, clinically significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT n = 201</td>
<td>77%</td>
<td>1.0%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>PTT n = 199</td>
<td>77%</td>
<td>0.5%</td>
<td>0.00%</td>
<td>0.00%</td>
</tr>
<tr>
<td>HCT n = 207</td>
<td>90%</td>
<td>0.7%</td>
<td>0.00%</td>
<td>0.2%</td>
</tr>
<tr>
<td>WBC n = 613</td>
<td>68%</td>
<td>5.4%</td>
<td>0.1%</td>
<td>0.00%</td>
</tr>
<tr>
<td>HbC n = 306</td>
<td>8.5%</td>
<td>0.3%</td>
<td>0.2%</td>
<td>0.00%</td>
</tr>
<tr>
<td>CBC n = 534</td>
<td>3.9%</td>
<td>8%</td>
<td>0.2%</td>
<td>0.3%</td>
</tr>
<tr>
<td>GLUC n = 408</td>
<td>7.8%</td>
<td>6.4%</td>
<td>0.5%</td>
<td>0.4%</td>
</tr>
<tr>
<td>Total</td>
<td>18.8%</td>
<td>9.3%</td>
<td>0.7%</td>
<td>0.2%</td>
</tr>
</tbody>
</table>


Experience with selective testing

- Cleveland Clinic experience with guided testing, using preoperative questionnaire, assessment of patient status and surgical risk then following indicated testing grid
Examples of selective testing decision trees

Maurer 2004 summary

- Use of the decision trees, ordering based on indications has allowed the practice to adapt to ongoing increases in case volume, with no negative impact on cancellations, etc
- More than 50% of scheduled patients are screened but not seen by the anesthesiologist until the day of surgery
- Volume seen in clinic (after screening criteria applied) has stayed same (about 14,000 per year) in face of growing surgery volume
- Overall cost to system "unchanged"
- Sicker, more complex patients being seen

What is the impact of NOT obtaining indicated testing before anesthesia?

- 1,061 patients randomized to indicated/testing or NO testing before outpatient surgery
- Indicated testing followed Ontario Preoperative Testing Grid
- Important disease and conditions were in the exclusion criteria
- Some patients "crossed over" based on personal or medical judgment
- More than 85% ASA 1 or 2
- About 35% > 60 years of age
- Compared adverse outcomes 7 and 30 days following surgery
Exclusion Criteria

- Cardiac disease:
  - Recent MI or class ≥3 angina
  - Dyspnea on exertion class ≥3
  - Arrhythmias
  - Coagulation disorder or significant anemia
  - Leukemia, lymphoma
- Severe liver disease
- Significant renal disease
- "Any other new or worsening medical condition that would warrant medical testing even if surgery was not planned"
- Previous preop testing in prior 30 days

Ontario Testing Grid

<table>
<thead>
<tr>
<th>Test</th>
<th>Criteria for obtaining test</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBC</td>
<td>Age &gt; 60, anemia suspected</td>
</tr>
<tr>
<td>Electrolytes, creatinine</td>
<td>On diuretics, renal disease, DM</td>
</tr>
<tr>
<td>Blood glucose</td>
<td>DM</td>
</tr>
<tr>
<td>PT/PTT</td>
<td>On anticoagulants, coagulopathy, chronic liver disease</td>
</tr>
<tr>
<td>Sickle cell screening</td>
<td>African or Caribbean origin</td>
</tr>
<tr>
<td>ECG</td>
<td>Age &gt; 45, cardiac history, hypertension</td>
</tr>
<tr>
<td>CXR</td>
<td>Pulmonary disease, heavy smoker</td>
</tr>
</tbody>
</table>

Adverse outcomes

<table>
<thead>
<tr>
<th>Type</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac</td>
<td>Myocardial ischemia or infarction</td>
</tr>
<tr>
<td></td>
<td>CHF Clinically significant BP change, arrhythmia</td>
</tr>
<tr>
<td>CNS</td>
<td>TIA</td>
</tr>
<tr>
<td>Respiratory</td>
<td>Failure</td>
</tr>
<tr>
<td>Endocrine</td>
<td>Hyper or hypoglycemia</td>
</tr>
<tr>
<td>Other</td>
<td>&quot;Any new or worsening medical problem requiring treatment&quot;</td>
</tr>
<tr>
<td>Administrative</td>
<td>OR delay, Cancellation, Unanticipated admission, Revisit within 7 and 30 days of surgery</td>
</tr>
</tbody>
</table>
Adverse events within 30 days

Table 1. Interventions and Postoperative Adverse Events Within 30 Days

<table>
<thead>
<tr>
<th>Event</th>
<th>No testing (n=499)</th>
<th>Testing (n=527)</th>
<th>Relative risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interventions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Endotracheal intubation</td>
<td>7.0 (6.0)</td>
<td>7.1 (6.3)</td>
<td>1.02 (95% CI: 0.95-1.10)</td>
</tr>
<tr>
<td>Hypotension</td>
<td>0.8 (0.6)</td>
<td>0.8 (0.7)</td>
<td>1.00 (95% CI: 0.90-1.11)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>5.6 (4.3)</td>
<td>6.7 (5.5)</td>
<td>1.2 (95% CI: 1.00-1.44)</td>
</tr>
<tr>
<td>Mass movement</td>
<td>0.9 (0.7)</td>
<td>1.2 (1.0)</td>
<td>1.3 (95% CI: 1.00-1.64)</td>
</tr>
<tr>
<td>Decreased respiratory effort</td>
<td>0.7 (0.6)</td>
<td>0.6 (0.5)</td>
<td>0.9 (95% CI: 0.70-1.10)</td>
</tr>
<tr>
<td>Urinary retention</td>
<td>3.8 (3.1)</td>
<td>4.4 (3.6)</td>
<td>1.1 (95% CI: 0.90-1.33)</td>
</tr>
<tr>
<td>Surgical site infection</td>
<td>10.5 (9.3)</td>
<td>11.4 (9.7)</td>
<td>1.1 (95% CI: 0.95-1.29)</td>
</tr>
<tr>
<td>Other events</td>
<td>20.3 (17.7)</td>
<td>21.7 (18.9)</td>
<td>1.1 (95% CI: 0.95-1.29)</td>
</tr>
</tbody>
</table>

Reasons for Revisit

<table>
<thead>
<tr>
<th>Within 7 days</th>
<th>Within 30 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>No testing n=499</td>
<td>Testing n=527</td>
</tr>
<tr>
<td>Severe pain</td>
<td>1</td>
</tr>
<tr>
<td>Bleeding</td>
<td>1</td>
</tr>
<tr>
<td>Infection</td>
<td>2</td>
</tr>
<tr>
<td>Urinary retention</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
</tr>
</tbody>
</table>
Who had adverse events?

<table>
<thead>
<tr>
<th>Table 2. Rates of Intraoperative and Postoperative Adverse Events According to Caused by Medical Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical status</td>
</tr>
<tr>
<td>ANA</td>
</tr>
<tr>
<td>ESR</td>
</tr>
<tr>
<td>Adverse reaction</td>
</tr>
<tr>
<td>Postoperative adverse events</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

What was the cost impact?

<table>
<thead>
<tr>
<th>Test</th>
<th>No Testing Group</th>
<th>Testing Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBC</td>
<td>382</td>
<td>405</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>297</td>
<td>301</td>
</tr>
<tr>
<td>Creatinine / urea</td>
<td>212</td>
<td>246</td>
</tr>
<tr>
<td>Blood glucose</td>
<td>170</td>
<td>176</td>
</tr>
<tr>
<td>ECG</td>
<td>421</td>
<td>423</td>
</tr>
<tr>
<td>CXR</td>
<td>77</td>
<td>81</td>
</tr>
<tr>
<td>Total</td>
<td>1,599</td>
<td>1,632</td>
</tr>
</tbody>
</table>

Savings / Cost

<table>
<thead>
<tr>
<th>No Testing Group</th>
<th>Testing Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>$18,938</td>
<td>$19,470</td>
</tr>
</tbody>
</table>

Implications:

- In carefully screened patients undergoing ambulatory surgery:
  - Pilot trial is encouraging: justifies larger / multicenter trial
  - No demonstrable benefit to lab testing in this study
  - No difference in outcomes between no testing and indicated testing groups may mean you can skip testing if patient has “OK” history/screen
  - You can save $ by this approach
System implications

- Application of indicated testing requires coordination across healthcare team
- Decisions about testing hinge on ACCURATE screening history
- Testing grids are then used to decide what to order

### Ontario Testing Grid

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</tr>
<tr>
<td>CXR</td>
<td>Pulmonary disease, heavy smoker</td>
</tr>
</tbody>
</table>


- Age < 50 AND healthy: no testing unless surgical indication
- ECG: age > 50; HTN; active or H/O cardiac or circulatory disease; cardiothoracic surgery
- CXR: major respiratory condition AND change of symptoms OR acute episode in last 6 months; CT surgery
- Serum chemistry: renal disease; major metabolic disorder such as adrenal or thyroid disease; diuretic therapy; chemotherapy
- UA: GI procedure
- CBC: hematologic disorder; vascular procedure; chemotherapy
- Coagulation studies: anticoagulation treatment; vascular surgery
- Pregnancy testing: "patients for whom pregnancy might complicate the surgery"
LLUMC current testing grid

- Always a “work in progress” that we refine as appropriate
- Maybe more conservative/more testing than yours: our patients trend toward "sicker" referral practice
- Decisions based on a number of factors
  - Age
  - BMI
  - Co-morbidity
  - Surgical complexity
  - Medications

LLUMC indications for tests

- If screening history reveals patient is otherwise HEALTHY
  - Age based (may omit if minimal surgery):
    - Pediatic: HCT/Hb currently accept finger stick point of care testing
    - > 30 years old: ECG
    - > 65 years old: ECG and hemoglobin
    - > 75 years old: ECG, hemoglobin, serum chemistries, CXR
  - Weight / obesity based (can assume # healthy if significant obesity)
    - BMI > 15: CBC, serum chemistries
    - BMI ≥ 40: CBC, serum chemistries, ECG; for other than minimal surgery medical assessment and likely ABG and echocardiogram

LLUMC indications for tests with co-morbid conditions

- Bleeding disorder = PT/PTT, CBC, ordered valuations and risk assessment
- Chest pain at rest, chest evaluation
- CHF = echocardiogram; unless 1st sign of surgery, earlier evaluation for risk assessment and any additional resources or optimization
- CNI disease = serum chemistries, ECG
- COPD poorly controlled = medical evaluation for optimization prior to surgery, chest x-ray, ECG, CBC
- CVA = ECG
- Diabetes (T2DM): if Diabetes for > 10 years, add HbA1C; Medical evaluation prior to surgery performed by surgeon/physician
- Diabetes (T1DM): prep-medical evaluation for optimization prior to surgery – Consider before discharging patient
- ETOH excess = CBC, serum chemistries, PT/PTT
- Hepatocellular jaundice = CBC, serum chemistries, ECG, LFT
- Hepatitis = PT/PTT, serum chemistries, ECG, LFT
- Hyperkalemia = CBC, serum chemistries
- Hypertension = > 130/80 = CBC, serum chemistries
- Hypothyroidism = TSH
- Malignancy = CBC, serum chemistries, FUO, ECG
- MI < 6 mo ago = echocardiogram, chest x-ray, CBC, serum chemistries, ECG
- MI > 6 mo ago, chest pain with activity, CV history (previous MI, valve surgery, ICA, congenital disease)
- Pregnancy, possible or suspected = QualiBHcg
- Radiation therapy, history of = chest x-ray, ECG
- Renal disease = serum chemistries
- Renal failure = CRI, CKD, ordered valuation
- Smoking > 20 pk years = chest x-ray, ECG
- Syncope, suspected = medical or cardiac evaluation
- Transplant, history of = Pre-op cardiac or medical evaluation for optimization, ECG
LLUMC indications for tests: surgical complexity

- Assuming patient is otherwise healthy, these are the minimum tests we currently require based on surgical risk:
  - Minimal risk to the patient independent of anesthesia, these are minimally invasive procedures with little or no blood loss; no open cavity procedures: no testing other than by medical condition.
  - Minimal to moderately invasive procedure, with EBL <500 ml (<5 – 7 ml/kg); must have hemoglobin/ HemaCue; if patient is anemic add type and screen.
  - Moderately to significantly invasive procedure, with EBL 500 – 1,500 ml (8 – 20 ml/kg); these procedures present moderate risk to patient independent of anesthesia; must have CBC; add type and screen.
  - Highly invasive procedures, with EBL >1,500 ml (>20 ml/kg); these present a major risk to patient independent of anesthesia: must have PT/PTT, serum chemistries, ECG; add type and cross.

LLUMC indications for tests: current medications

- In addition to any testing indicated on other grids, patients on certain medications need:
  - ACE / ARB = serum chemistries
  - Antiarrhythmics = ECG, pre-op cardiac evaluation and risk assessment (send copy of any cardiac testing done in last year)
  - Anticoagulants = CBC, PT/PTT – Warfarin = + medicine evaluation
  - Antidiabetics (pills or insulin) = serum chemistries
  - Digoxin = serum chemistries, ECG, consider pre-op Digoxin level
  - Diuretics = serum chemistries
  - Steroids = serum chemistries

Predicting perioperative complications

- Big 3 continue to be: ASA class, surgical complexity and age
- Assignment of ASA class is troubled by subjectivity
- Other scoring systems:
Expanding reach

- Preanesthesia evaluation CAN be done in a system-based manner

Yen, Tsai, Macario: Preoperative evaluation clinics. CurrOpinAnaesthesiol 2010; 23:167-172


Mangi, Perrette, Antociari, Einton, Bannan, Trotter: Diagnostic accuracy of anesthesiology evaluation during the "One-Stop Anesthesia" in pediatric day surgery. Pediatric Anesthesia 2009; 19:764-769

- Organized clinics can and do improve

  - Efficiency on day of surgery
  - Application of indicated testing
  - Consider a role for
    - Computerized health screening
    - Telephone screening (for example: Law Hong Kong Med J 2009;15:179-82)
  - Other models

Key components of PAE

- **History**
  - Continues to be the cornerstone of providing medical care
  - Provides direction for further evaluation and planning

- **Physical exam**
  - Verifies suspected findings
  - Allows planning for airway, access

- **Indicated testing**
  - Many patients DON’T need testing before anesthesia / surgery
  - BUT the safe care of many patients DOES depend on appropriate testing

- **Thoughtful** interpretation of these factors goes into making a comprehensive plan for perioperative care.

Be sure to see what is there, not just what you expect to find

“Say, what’s that goat doing way up here in the clouds?”