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Perioperative Laboratory and Cardiac Testing: What is Necessary?

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Stem Case and Key Questions Content

The patient is a 62-year-old male with osteoarthritis scheduled for a right inguinal herniorrhaphy. He is in good shape and jogs 3-5 miles 3-4 times/week. He takes no medications, and has no known drug allergies. He is a busy cardiologist and calls the Center for Preoperative Evaluation 3 days prior to his scheduled surgery for details.

Stem Case-Key Questions

He speaks to the secretary and asks whether his history could be taken as a phone screen. The secretary transfers him to a nurse who starts taking the history for a phone screen. The nurse asks him about his age, and immediately "fails him" for the phone screen when the nurse finds out that he is 62 years old.

Why cannot his history be taken as a phone screen?

The patient is quite upset and asks to speak to a physician anesthesiologist. The anesthesiologist informs the patient that according to hospital guidelines he will need a preoperative CBC, and an electrocardiogram.

Does he really need this workup?

Is this workup going to affect the type of anesthetic or the perioperative management that he will receive?

Is the additional workup going to increase the safety of the surgery?

The patient works as a cardiologist who runs the stress-testing laboratory at a hospital in the other side of town, and just wrote an editorial for a leading cardiology journal titled "The impact of emerging guidelines on nuclear cardiology". He explains to you the meaning of guidelines, and asks if you could waive them.

What is the difference between standards, guidelines, and practice parameters?

Can you waive guidelines, or is he trying to be tricky with you?

You state that you work in a big group practice, and that it is easier to follow the guidelines in order to satisfy different practitioners. He tells you that he had an ECG during his routine physical a few months ago.

Does he really need an ECG?

For how long is an ECG previously done valid?

He understands your concern to satisfy different practitioners, but tells you that he does not have time to go to your center for a preoperative evaluation. He inquires whether he could have the ECG and CBC done at the hospital where he works.

Can you use laboratory workup and ECG from outside institutions?

Can you use a type and screen from outside institutions?

Does he need to have a history and physical at your preoperative center, or will his H&P from his PCP suffice?

The patient is accompanied by his 33 years-old daughter who is having a diagnostic hysteroscopy as part of an infertility workup.

Is there any additional question that you would ask her?

Does she need a preoperative pregnancy testing? If so, can a urine HCG suffice?

The patient tells you that his brother who is 71 years old who leaves out of town is coming to your facility for a lower extremity distal bypass vascular procedure.

Does the fact that his brother is 71 years old make a difference as far as the workup that is necessary?

Does the ASA classification affect your decision to order laboratory tests?

Does the type of surgery make a difference as far as laboratory workup?

Upon further history, you find out that his brother gets chest pain with strenuous exercise?

What is important to ask him on the history?

Would you immediately get a cardiology consultation?

Suppose that he didn't have any prior workup. Is there any testing that may assist you on your risk assessment?

Let us now assume that he had some prior cardiac testing. Does he need any further workup?

Let us assume that he had some prior coronary intervention. Does he need any further workup or treatment?

His brother scheduled for a vascular procedure had a nuclear cardiology stress test done at an outside facility six months ago that demonstrated a small to moderate area of stress induced ischemia of moderate intensity in the inferior wall.

Is there any other workup that you would recommend prior to his visit to the preoperative test center?

Is there any benefit of postponing this case in order to perform an angioplasty or coronary artery bypass graft?

Let us assume that the case is postponed in order to perform an angioplasty. How long do you have to wait prior to performing the hip replacement following a percutaneous coronary intervention? Does it make a difference if the percutaneous coronary intervention is performed with drug eluting or bare metal stents?

Let us assume that the patient prefers medical management. Are there any particular agents that would be helpful for this patient having this particular surgical procedure?

Model Discussion Content

Preoperative Assessment Testing Clinics coordinate preoperative surgical, anesthesia, nursing and laboratory care. Such clinics have been noted to lead to efficiencies in perioperative care by seeing most patients days before the surgery. The prior history, medical records, previous tests and consultations are reviewed, and a medical history and physical examination are conducted. Laboratory testing, electrocardiogram, and chest x-ray should be ordered if necessary, and it is essential to determine which patients need further workup or consultations in order to assess the patient's readiness for surgery. For the clinician, the goals of preoperative assessment have multiple purposes: to assess the patient's condition for anesthesia and surgery, to discuss and explain anesthetic and surgical options, to reduce anxiety, to discuss postoperative pain management options, to coordinate patient care among different members of the medical team, and to obtain informed consent (1).

Decades ago advances in technology with the introduction of multiphasic battery of lab tests led to an increase in the number of tests ordered with the assumption that early presymptomatic diagnosis will optimize care and reduce medical costs. However, Roizen brings up the issue that more testing is likely to lead to an increase number of abnormal results because most tests have a specificity of 95% (2). One out of 13 tests is likely to be abnormal and lead to further unnecessary workup with an increase in medical costs and the possibility of increased morbidity. In addition, the medicolegal risk is greater if a test is ordered and not followed than if a test is not ordered based on the patient's history (3). Preoperative testing should be based on a targeted history and physical examination, on the patient's comorbidities and on the type of surgery. It is important to avoid repetition of prior testing if there is no change in the patient's condition, and to avoid testing in healthy patients having minimally invasive procedures. Routine testing does not increase safety or the possibility of surgery cancellation, even in elderly patients with multiple comorbidities, for minimally invasive procedures such as cataract surgery

(4).
Controversy exists whether age should be criteria for ordering preoperative laboratory workup. Dzankic and colleagues demonstrated that although there is an increased incidence of abnormal creatinine, hemoglobin and serum glucose in elderly patients, only the ASA classification and the type of surgical procedures were predictive of postoperative complications (5). In summary, routine testing is not indicated and should only be ordered based on the history, physical examination and type of surgical procedure. Laboratory testing should not be used randomly in order to detect an unknown abnormality, as it is not a good screening device. Routine ECGs have been reported to be abnormal in 7.0-42.7% of cases in 12 different studies but led to changes in management in only 10% of these cases (6). The rate of ECG abnormalities and changes in management increased when the ECG was ordered based on the history and physical examination. Important clinical characteristics to consider when making a decision to order an ECG include cardiovascular or respiratory disease, multiple cardiac risk factors, and the surgical risk. There is currently no consensus regarding a minimum age for obtaining an ECG prior to a noncardiac surgery (6). The ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery discourage preoperative ECGs in asymptomatic persons undergoing low-risk surgical procedures regardless of age (7). Even though ECG abnormalities are more common in older patients, they are not predictive of postoperative complications (8). van Klei evaluated the value of a preoperative ECG in predicting postoperative cardiac complications in patients that were admitted following their surgical procedure and concluded that abnormalities in the ECG did not provide any additional information beyond that of risk factors including history of ischemic heart disease and high-risk surgery (9). Similar results have been found by Noordzij (10) and Liu (8) in patients undergoing low to intermediate risk surgery and intermediate to high risk procedures respectively. Therefore, a preoperative ECG ordered routinely in those older than 50-60 years does not seem to add any value in predicting postoperative complications beyond cardiac risk factors. However, despite the fact that there is little data regarding a specific age cutoff where there are significant ECG changes predictive of postoperative cardiac complications, some experts have recommended ECG in patients over 60 years of age (11), and for older patients (no specific age given) undergoing major noncardiac surgical procedures (12). Patients at higher risk of having a significantly abnormal ECG are those older than 65 years of age or who had a history of heart failure, high cholesterol, angina, myocardial infarction, or severe valvular disease (13).

The goal of the perioperative cardiovascular evaluation is to evaluate the current medical status of the patient, provide a risk assessment, and make recommendations based on the evaluation to decrease the risk of cardiovascular events. Findings from the history and physical exam including exercise tolerance, clinical risk factors, surgical risk stratification, and prior coronary evaluation and treatment can be used in the decision to perform further diagnostic testing and resultant perioperative management (7). It could also help shape decisions about the advisability and extent of surgery. It is important to realize that cardiac testing should never be performed unless the results will have an impact on perioperative management and eventual outcome. Although there are no studies that address the timing of the preoperative evaluation, it makes sense to schedule it at least 48 hours in advance to the surgical procedure in order to allow for additional testing and treatment that may be warranted.

Current guidelines for cardiac risk stratification rely on functional capacity, clinical predictors and the relative risk of surgery (7). The probability of silent cardiovascular disease could be elicited

by the presence of obvious symptoms during the history taking. The patient's functional capacity is assessed by daily living activities and exercise capacity, and is used to evaluate symptoms of potential cardiovascular disease such as shortness of breath and chest pain (14). Coronary artery disease is commonly associated with vascular disease and is the leading cause of mortality after vascular surgery (15), but unfortunately most of these patients are unable to exercise due to lower extremity claudication. This makes routine clinical evaluation neither completely sensitive nor specific for cardiac risk estimation due to the inability to assess the functional capacity in these patients. The end result of having a high-risk procedure together with the inability to evaluate exercise capacity led to excessive preoperative evaluation and treatment in the early 1990s. Even though the risk of a cardiac event depends somehow on the risk of surgery, any needed intervention should be performed independent of the type of surgical procedure and not just to get the patient through surgery.

Cardiac risk factors are generally utilized as clinical predictors for coronary artery disease and are elicited based on the history and physical examination. The most recent perioperative guidelines use the revised cardiac risk index developed by Lee and colleagues for the prediction of heart disease for stable patients (16). This index identified six independent risk correlates, including ischemic heart disease, congestive heart failure, cerebral vascular disease, high risk surgery, diabetes mellitus and chronic renal failure, where increasing number of risk factors correlated with increased risk for major cardiac complications. Although other minor risk factors were included in the 2002 guidelines, there are no longer utilized in the revised guidelines. The American Society of Anesthesiologists (ASA) classification has also been correlated with adverse cardiovascular events. The higher the ASA classification the more likelihood of cardiac morbidity and mortality (5, 17). Not only is it essential to take into account the patient's cardiac risk factors, but also the relative risk of surgery in order to appropriately develop guidelines for preoperative testing. The relative risk of surgery is based on the risk of developing cardiac death and myocardial infarction during noncardiac surgery and is divided into high, intermediate and low risk surgical procedures (7). The risk of cardiac events ranges from 5% for high-risk procedures.

It is important to point out that the risk of death from a coronary artery bypass graft (CABG) is greater than that for most other procedures. A multicenter study of patients having document coronary artery disease by angiogram and scheduled for a vascular procedure, demonstrated no advantage of coronary revascularization (CABG or percutaneous coronary intervention) compared to aggressive medical management prior to the vascular procedure (18). There was no difference in the postoperative myocardial infarction within 30 days of the vascular procedure, or in the mortality at 2.7 years. The only difference demonstrated between the two groups was the time from randomization to the vascular procedure, 54 days in the revascularization group compared to 18 days in the medical therapy group. The authors concluded that revascularization should be saved for patients with unstable coronary symptoms or advanced coronary artery disease. The latest perioperative guidelines recommend revascularization for patients with stable angina and significant left main coronary artery stenosis, 3-vessel disease or 2-vessel disease with significant proximal left anterior descending stenosis and decreased ejection fraction (7). Of note, a CABG performed within close proximity to the proposed surgery, and where there is a proven survival benefit, is effective in lowering perioperative cardiac morbidity (15).

Interestingly, coronary stent placement within 15 days of noncardiac surgery has been reported

to increase the risk of stent thrombosis with resultant myocardial infarction and cardiac death (19). In addition, perioperative bleeding episodes were more common within 2 weeks of stenting. Therefore, it has been recommended to wait at least 4-6 weeks following a percutaneous coronary intervention. More recent evidence has also questioned the practice of discontinuing anti-platelet therapy, especially thienopyridine (e.g., clopidogrel or ticlopidine), prematurely following stent placement (20-21). Although thienopyridine therapy may be discontinued one month following a bare metal stent, more recent evidence demonstrates the risks of discontinuing anti-platelet agents before 12 months of therapy in patients with drug eluting stents (20-21). A 2007 update of the ACC/AHA guidelines for percutaneous coronary intervention recommends that after a percutaneous coronary intervention (PCI), in patients without allergy or increased risk of bleeding, aspirin 162 mg to 325 mg daily should be given for at least 1 month after bare metal stent implantation, 3 months after sirolimus-eluting stent implantation, and 6 months after paclitaxel-eluting stent implantation, after which daily long-term aspirin use should be continued indefinitely at a dose of 75 mg to 162 mg (22). For all post-PCI stented patients receiving a drug eluting stent (DES), clopidogrel 75 mg daily should be given for at least 12 months if patients are not at high risk of bleeding. For post-PCI patients receiving a bare metal stent (BMS), clopidogrel should be given for a minimum of 1 month and ideally up to 12 months (22).

Beta blockers have been demonstrated to be beneficial in preventing cardiac morbidity and death in patients with known coronary artery disease or with multiple risk factors (23-25). Patients without known coronary disease but at significant risk include those undergoing vascular surgery, as well as those with other risk factors such as diabetes mellitus especially when long lasting and associated with end organ damage (26). Beta blockers may also be beneficial in patients with numerous cardiac risk factors including left ventricular hypertrophy, $\geq$ 65 years old, male sex, cigarette smoking, diabetes mellitus, uncontrolled hypertension, increased serum cholesterol and peripheral vascular disease (23). Contraindications to beta blockers include a history of intolerance, severe bronchospasm, decompensated heart failure, and third degree atrioventricular block in the absence of a pacemaker. Although there may be a benefit to start beta blockers several days or weeks prior to the proposed procedure (24), there is also a benefit in starting them the day of the procedure (23). Additionally, they should be continued in the postoperative period until hospital discharge (23-25).

More recent data from the Peri-Operative ISchemic Evaluation (POISE) trial suggests that in patients with CAD or with cardiac risk factors, at a high dose of metoprolol (200 mg), the primary outcome following noncardiac surgery comprising cardiovascular death and nonfatal myocardial infarction or cardiac arrest were significantly decreased in the beta-blocker group (26). However, it did so at the risk of increased stroke, the single most important independent postoperative predictor of death in this trial. It is unclear how to interpret this finding, as the high dose of metoprolol used in that study may not be the appropriate choice, and further research over dose ranges and time of initiation will be necessary to truly elucidate the impact (27). A 2009 practice guideline by the American College of Cardiology/American Heart Association Task Force on perioperative cardiovascular evaluation for noncardiac surgery summarized the evidence behind perioperative beta-blocker therapy (28). Recommendations on their use were based on the presence of known coronary artery disease, cardiac risk factors, type of surgery and surgical risk. These updated guidelines acknowledge that data from POISE suggest that starting higher doses of beta blockers acutely on the day of surgery is also associated with risks. Therefore, careful patient selection, dose adjustment and monitoring throughout the

perioperative period are recommended. They further recommend that beta blockers be started ahead of surgery and question the usefulness of beta blockers in lower-risk patients or in those undergoing lower-risk surgeries. A 2010 study on low dose beta blocker therapy and perioperative risk supports these guidelines (29). In patients with coronary artery disease scheduled for vascular surgery, there was no association between beta-blocker use and postoperative stroke in a regimen started at least 30 days before surgery (29).

Other evidence has demonstrated that the perioperative use of statins may reduce cardiovascular risk (30-32). A review of published studies demonstrated that the perioperative use of statins was associated with lower adverse cardiovascular morbidity and mortality. The authors recommended that it would be reasonable to start statin therapy during the perioperative period in patients with known, or at significant risk for, coronary artery disease. However, since most of the evidence was from observational data, the authors stopped short of recommending the routine use of perioperative statins to decrease cardiovascular risk (30). A meta-analysis also demonstrated the value of preoperative statin therapy in reducing postoperative mortality after cardiac, vascular and noncardiac surgery (31). However, the authors were cautious about recommending routine statin therapy, as most of the data was derived from retrospective studies. These two studies support the notion that statin therapy should not be stopped prior to surgery and that it should be started as soon as feasible in the postoperative period. A more recent prospective randomized study in patients with coronary artery disease demonstrated that perioperative fluvastatin therapy started at least 30 days before vascular surgery was associated with a reduced incidence of myocardial ischemia (MI) and the composite of MI and cardiovascular death at 30 days following surgery (32). The 2007 ACC/AHA guidelines consider statin use reasonable for patients undergoing vascular surgery and state that their use may be considered for patients with at least one cardiac risk factor and undergoing intermediate risk procedures (7).

In conclusion, the cardiac preoperative evaluation of the noncardiac patient relies in the consideration of information from multiple sources including the medical record, history and physical examination and findings from medical tests including the ECG. Additional factors to be considered include coexisting medical disease, clinical risk factors, the type and invasiveness of the surgery, and the patient's functional capacity. Additional cardiac evaluation in the form of exercise or pharmacologic stress tests is rarely necessary. Additional tests, evaluations and consultations should only be done if the information to be obtained will result in changes in the perioperative management of the patient. Different management options include postponement of elective surgery, initiation or modification of risk-reduction medical therapy with beta-blockers and statins, change in perioperative monitoring and coronary revascularization. In addition, the benefits of any additional intervention should exceed the potential adverse effects. Furthermore, additional procedures should not be done if the purpose is just to get the patient through surgery. Coronary interventions should only be performed if there are deemed necessary regardless of the surgery.

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