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The Philippine College of Surgeons Evidence-Based Clinical Practice Guidelines on Preoperative Evaluation of ASA I and II Adult Patients Undergoing Elective Non-Cardiac Surgery

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It is the practice in most health care institutions in our country to have patients for elective surgery evaluated pre-operatively by Internists and Anesthesiologists. Practitioners don't seem to agree on how this is to be carried out. Each institution has its own protocol and even individual physicians have their own preference, which they have learned either during their training or from experience.

Physicians usually request for preoperative tests for patients undergoing elective surgery in order to minimize risk, and to serve as a baseline to detect subsequent changes.[1] Several authors agree to this as the goal of pre-operative evaluation. This is being done to identify risk factors and to screen broadly for undiagnosed disease.[2,3] Undiagnosed clinical conditions are correlated with the risk of complications during the perioperative period.[4] This then allows the physician to identify patients with increased risk of morbidity and mortality, and to help them design preoperative strategies that can reduce these risks.[3,5] These tests can be helpful to stratify risk and guide postoperative management; however, most of them are obtained because of protocol rather than medical necessity.

Majority of surgeries performed are non-cardiac in nature. Mortality rates for these procedures can be as high as 4% depending on the patient's risk and type of surgery.[6] Cardiovascular complications account for half of all morbidities and mortalities in the perioperative period for patients undergoing non-cardiac surgery. This is considered a significant contributing factor to perioperative morbidity and mortality.[3]

Preoperative evaluation also promotes patient engagement and helps facilitate shared decision making by providing patients and their providers with clear, understandable information about perioperative cardiovascular risk in the context of the overall risk of surgery.

In light of the evolving nature of elective surgery, increased attention has been placed on pre-operative evaluation.[7] All patients require a history and physical examination and for some patients, this may be the only necessary evaluation. Clinically important abnormalities can usually be predicted from a complete history and physical examination. Some authors report that 60-70% of laboratory tests ordered before general surgery are not really necessary.[4,8,9]

Age is a very important factor. In asymptomatic patients who are 50 years of age and older, a more extensive assessment of history and physical examination is warranted, because of higher incidences of undiagnosed medical conditions. The incidence of abnormal laboratory examinations was also observed to increase in this subset of patients.[4,10]

For these reasons, a renewed focus on the utility of routine laboratory assessment to guide or predict perioperative care and outcomes has been the subject of several systematic reviews and guidelines.

Although guidelines on preoperative evaluation have been published by the American Society of Anesthesiologists (ASA), American College of Cardiology (ACC)/American Heart Association, Inc. (AHA) and the National Institute of Health and Care Excellence (NICE), the Philippine College of Surgeons (PCS) through its Committee on Surgical Research found a need to formulate these Evidence-based Clinical Practice Guidelines (EBCPG), to make them applicable to our setting, and to focus on the ASA I and II patient who will undergo an elective non-cardiac surgery. The ASA Classification of Physical Status is the most widely used preoperative clinical assessment tool. It is generally accepted as a good predictor of postoperative outcome.[11] This grading system is used to evaluate the degree of a patient's physical state or illness before selecting the anesthetic or before performing surgery (Table 1).

These guidelines are intended for the use of attending physicians, sur-geons and anesthesiologists, to minimize unnecessary tests and referrals prior to surgery. They are based on the most recent available scientific evidence and the views of local experts on current practices in the preoperative evaluation of the ASA I and II patients undergoing elective non-cardiac surgery. They are merely recommendations and are not the only acceptable methods of preoperative evaluation. These guidelines should be modulated by patients' preferences, socio-cultural circumstances and other factors that may influence the management of individual patients. They are not intended to serve as the basis for court litigations, sanctions or related issues.

The PCS Foundation provided funding for this project.

Executive Summary

The Technical Working Group (TWG)was composed of members of the PCS Committee on Surgical Research (CSR), an epidemiologist, and representatives from other specialty organizations. The group convened on June 8, 2016 to establish the basic framework of the EBCPG. Important issues were discussed, and clinical questions were developed, which were approved by the PCS Board of Regents on June 25, 2016.

Table 1. ASA Physical Status ClassificationSystem.

ASA PS Classification	Definition	Examples, including, but not limited to:
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Examples include (but not limited to): current smoker, social alcohol drinker, pregnancy, obesity (30 < BMI < 40), well-controlled DM/HTN, mild lung disease
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Examples include (but not limited to): poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, premature infant PCA < 60 weeks, history (>3 months) of MI, CVA, TIA, or CAD/stents.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Examples include (but not limited to): recent (< 3 months) MI, CVA, TIA, or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis
ASA V	A moribund patient who is not expected to survive without the operation	Examples include (but not limited to): ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

*The addition of "E" denotes Emergency surgery: (An emergency is defined as existing when delay in treatment of the patient would lead to a significant increase in the threat to life or body part)

Reference: AmericanSocietyofAnesthesiologists. https://www.asahq.org/resources/clinical-information/asa-physical-status-classification-system. Accessed 11/30/2016.6

The TWG is composed of the following:

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Literature search using electronic database Pubmed (Medline) of the U.S. National Library of Medicine, UpToDate and others was done. Key words used for the search included the following MeSH terms: "preoperative evaluation", "preoperative risk assessment", "preoperative testing", "elective non-cardiac surgery", 'perioperative risk". Relevant articles were retrieved and appraised, including the latest guidelines from ASA, NICE, ACC/AHA. Cross-referencing was done. A manual search was done to retrieve the full text of some journals. A total of 45 articles were used.

The group held a meeting September 10, 2016 to appraise the articles and evaluate the level of evidence using Oxford Center for Evidence Based Medicine, 2011. On October 4, 2016, recommendations were proposed for each clinical question based on the corresponding best scientific evidence. The first draft of the clinical practice guidelines was then prepared.

To ensure acceptability of the guidelines by the other specialties, this first draft was presented to a Multisectoral Expert Panel in an en banc meeting organized by the PCS on December 6,2016 during the Annual Clinical Congress. The panel ratified the evidence, then graded and formalized the recommendations using the Nominal Group Technique, assuring unopposed generation of

Table 2. Oxford Centre For Evidence-Based Medicine 2011 Levels of Evidence.

Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence

Question	Step 1 (Level 1*)	Step 2 (Level 2*)	Step 3 (Level 3*)	Step 4 (Level 4*)	Step 5 (Level 5)
How common is the problem?	Local and current random sample surveys (or censuses)	Systematic review of surveys that allow matching to local circumstances**	Local non-random sample**	Case-series**	n/a
Is this diagnostic or monitoring test accurate? (Diagnosis)	Systematic review of cross sectional studies with consistently applied reference standard and blinding	Individual cross sectional studies with consistently applied reference standard and blinding	Non-consecutive studies, or studies without consistently applied reference standards**	Case-control studies, or "poor or non-independent reference standard**	Mechanism-based reasoning
What will happen if we do not add a therapy? (Prognosis)	Systematic review of inception cohort studies	Inception cohort studies	Cohort study or control arm of randomized trial*	Case-series or case-control studies, or poor quality prognostic cohort study**	n/a
Does this intervention help? (Treatment Benefits)	Systematic review of randomized trials or *n*-of-1 trials	Randomized trial or observational study with dramatic effect	Non-randomized controlled cohort/follow-up study**	Case-series, case-control studies, or historically controlled studies**	Mechanism-based reasoning
What are the COMMON harms? (Treatment Harms)	Systematic review of randomized trials, systematic review of nested case-control studies, *n*-of-1 trial with the patient you are raising the question about, or observational study with dramatic effect	Individual randomized trial or (exceptionally) observational study with dramatic effect	Non-randomized controlled cohort/follow-up study (post-marketing surveillance) provided there are sufficient numbers to rule out a common harm. (For long-term harms the duration of follow-up must be sufficient.)**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning
What are the RARE harms? (Treatment Harms)	Systematic review of randomized trials or *n*-of-1 trial	Randomized trial or (exceptionally) observational study with dramatic effect			
Is this (early detection) test worthwhile? (Screening)	Systematic review of randomized trials	Randomized trial	Non -randomized controlled cohort/follow-up study**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning

*** Level may be graded down on the basis of study quality, imprecision, indirectness (study PICO does not match questions PICO), because of inconsistency between studies, or because the absolute effect size is very small; Level may be graded up if there is a large or very large effect size.**

**** As always, a systematic review is generally better than an individual study.**

ideas from all participants. Following suggestions from the expert panel, the second draft was prepared and sent to the members of the panel by email on March 2017 for their approval. The final draft will be presented in a Public Forum on May 2017 during the PCS Mid-year Convention in Cagayan de Oro.

Members of the Expert Panel:

1. Edgar A. Baltazar, MD (PCS Board of Regents)
2. Armando C.Crisostomo, MD (PCS)
3. Nemencio A. Nicodemus Jr., MD (Philippine Society of Endocrinology & Metabolism)
4. Annabelle S. Lim, MD (Philippine Society of Nephrology)
5. Roberto O. Domingo, MD (Philippine Society of General Surgeons)
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7. Catherine Nunez, MD (Philippine Association of Plastic, Reconstructive and Aesthetic Surgeons)
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9. Servando Sergio DC, Simangan Jr., MD (Philippine Society of Transplant Surgeons)
10. Luisito O. Llido, MD (Philippine Society of Parenteral and Enteral Nutrition)

Recommendations were graded as follows:

Categories of Recommendations

Category A	At least 75% consensus by expert panel present
Category B	Recommendation somewhat controversial and did not meet consensus
Category C	Recommendation caused real disagreements among members of the panel

Clinical Questions:

1. Among ASA I & II adult patients for elective non-cardiac surgery, what preoperative tests are recommended?

2. What additional non-patient risk factors (such as type of surgery, type of anesthesia, length of surgery, etc.) should be considered when ordering preoperative tests?

3. Which other risk assessment tools aside from ASA classification (functional capacity, type of surgery, etc.) is recommended for adult patients for elective non-cardiac surgery?

Summary of Recommendations:

1. Among ASA I & II adult patients for elective non-cardiac surgery, what preoperative tests are recommended?

   A thorough history and PE is sufficient in the evaluation of patients for elective non-cardiac surgery.

   For those classified ASA I, routine preoperative testing is not recommended.

   For those classified ASA II, preoperative testing is recommended only if clinically indicated.

Level 2 Category A

Summary of Evidence

There is no evidence derived from high-quality studies that supports routine preoperative testing in healthy adults undergoing non-cardiac surgery. Several systematic reviews explored whether preoperative testing leads to changes in management or reduces perioperative mortality or morbidity in unselected patients undergoing elective, non-cardiac surgery. These studies showed no

significant difference in perioperative outcome.[1,8,10,12,13] Diagnostic evaluation is not necessary if the intention is to simply lower the risk of complications from surgery. Such interventionis only indicated to further investigate abnormal findings noted on the history and physical examination.

Garcia in his 2014 paper analyzed whether preoperative tests in elective surgeries are ordered according to clinical criteria. The correlation between ASA physical status classification with the diagnostic examinations ordered is shown in Figure 1. The paper showed that 41.9% of tests performed in patients classified as ASA I was not indicated. In patients classified as ASA II, 442 tests (17.72%) were made without necessity.[9]

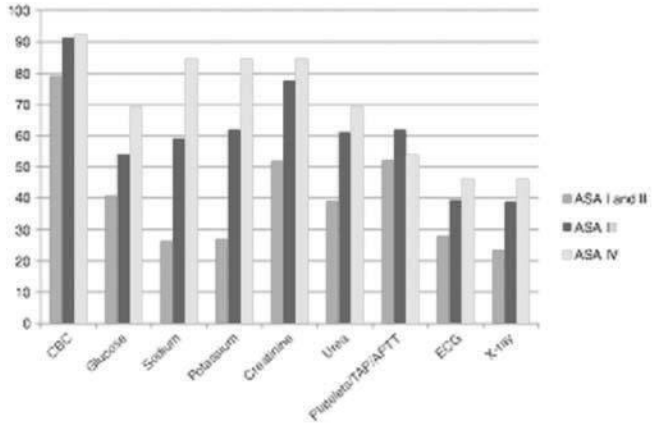

Figure 1. Correlation of ASA status of patients with the results of diagnostic examinations ordered.[9]

The efficacy of performing specific diagnostic examinations was investigated in several of these papers. Correlating it with the local practice, the authors obtained evidence for the use of Complete Blood Counts, Electrocardiograms, Co-agulation Studies, Blood Sugars, Urinalysis, and Chest x-rays.

CBC

Johannson and Feely found no valid evidence suggesting that routine preoperative complete blood count, specifically measurement of hemoglobin orhematocrit values will lead to a change in clinical manage-mentor outcome in patients without pre-existing conditions or signs of anemia in clinical examination and medical history. Likewise, there was no valid evidence supporting routine preoperative WBC or CRP testing in asymptomatic patients.[1,12]

A complete blood count is indicated for patients with diseases that increase the risk of anemia or patients in whom significant perioperative blood loss is anticipated. For this subset of patients, the prevalence of anemia is relatively low. None of the guidelines recommend indiscriminate preoperative CBC or hemoglobin testing.[1,12]

ECG

Routine preoperative resting 12-lead ECG is not useful for asymptomatic patients undergoing low-risk surgical procedures. It is reasonable for a certain subset of patients (those with known coronary heart disease, significant arrhythmia, peripheral arterial disease, cerebrovascular disease, or other significant structural heart disease) undergoing medium or major surgery. It may be considered for asymptomatic patients without known coronary heart disease, except for those undergoing low-risk surgery.[2,12] Abnormal ECG results changed the cardiac risk level in 8.7% of such patients, although these situations did not interfere with the surgical procedure.[4]

Below is a summary of recommendations taken from the 2014 ESC/ESA Guidelines on non-cardiac surgery:[14]

Chest X-ray

There is a lack of high-quality evidence supporting the use of routine preoperative chest radiography. The guidelines concur that performing it in asymptomatic, healthy patients is not indicated. This is mainly because it rarely alters perioperative management in these cases. Therefore, it cannot be recommended on a routine basis.[5,12,15,16]

Chest x-ray should not be offered routinely to healthy individuals undergoing non-cardiac surgery. The literature provides no evidence on the clinical

Table 3. ESC/ESA Recommendations on routine pre-operative ECG.

Recommendations on routine pre-operative ECG

Recommendations	Class[a]	Level[b]	Ref.[c]
Pre-operative ECG is recommended for patients who have risk factor(s)[d] and are scheduled for intermediate- or high-risk surgery.	I	C	57
Pre-operative ECG may be considered for patients who have risk factor(s) and are scheduled for low-risk surgery.	IIb	C	
Pre-operative ECG may be considered for patients who have no risk factors, are above 65 years of age, and are scheduled for intermediate-risk surgery.	IIb	C	
Routine pre-operative ECG is not recommended for patients who have no risk factors and are scheduled for low-risk surgery.	III	B	71

ECG = electrocardiography.
[a]Class of recommendation.
[b]Level of evidence.

effectiveness and cost-effectiveness of this test in this specific patient group. No test should be performed unless it is likely to influence patient treatment.[10,15,16]

Coagulation Studies

All the guidelines do not routinely recommend the performance of coagulation tests before surgery as the predictive values for each of these screening tests are limited.[8,15] There are no valid evidences for routine preoperative coagulation testing. Performing the tests will not lead to a change in clinical management or outcome in asymptomatic patients. The use of these tests is only recommended if there are specific risk factors in the patient's history.

Coagulation studies are reserved for patients with a history of bleeding or medical conditions that predispose them to bleeding (like liver disease), those taking anticoagulants, and those with history of an underlying coagulation disorder. An accurate bleeding history should be obtained from all surgical patients, and appropriate coagulation testing should be considered only if there are specific risk factors.The routine use of coagulation tests is not recommended.[1,5,12]

Blood Sugar

Among the guidelines, there is no clear consensus on preoperative glucose testing. There are some that recommend performing it based on the clinical setting, while others recommend doing it on the basis of the presence of co-morbid conditions, surgical risk and medication use.[12]

It is not recommended to test blood sugar levels routinely during the preoperative preparation of a healthy individual about to undergo non-cardiac surgery.[5,13,16]

Kidney Function Tests

There is no evidence that justifies routine testing for renal function, electrolytes, and urine analysis in asymptomatic subjects without a history of renal disease or electrolyte disorder. Because of this,urinalysis is not recommended as a routine test before surgery.[1,5,12,16]

Several case series have shown that the incidence of abnormalities is up to 34 percent, but only lead to a change in management in less than 14 percent, and of those patients, less than 1 percent had postoperative complications. There is little evidence that an abnormal result is associated with post-operative complications. This shows that the predictive values of routine urinalysis in asymptomatic patients are poor.

Preoperative urinalysis is recommended for patients undergoing invasive urologic procedures and those undergoing implantation of foreign material.[12]

The aforestated tests do not make an important contribution to the process of perioperative assessment and management of the patient. The decision to recommend further testing can be considered a balancing act between the estimated probabilities of effectiveness versus risk. Unnecessary testing may even cause harm due to over treatment of borderline or false-positive results.[4,10,14]

Tests may be performed on a selective basis for purposes of guiding or optimizing perioperative management. The patient's clinical history, comorbidities, and physical examination findings can help guide the surgeon on when to order pre-operative testing. The use of testing should be limited to those circumstances in which the results of such tests will clearly affect patient management.[10,12,14]

Indiscriminate use of laboratory examinations increase costs without reducing preoperative complications. They often do not change perioperative management, may lead to follow-up testing with results that are often normal, and can unnecessarily delay surgery, all of which increase the cost of care. The value of these preoperative tests should be seen in terms of their clinical effectiveness and cost-effectiveness in the identification of specific clinical abnormalities in patients with a known underlying risk.[4,12,15]

2. What additional non-patient risk factors (such as type of surgery, type of anesthesia, length of surgery, etc.) should be considered when ordering preoperative tests?

   The type of surgery is an important consideration in determining cardiac risk and the need for preoperative tests.

   For intermediate to high risk surgery, the following preoperative tests are recommended:

   - CBC or Hemoglobin for surgery in which significant blood loss is anticipated
   - Kidney function tests (creatinine, electrolytes, BUN) if patient is at risk for acute kidney injury
   - ECG for ASA I patients age 65 or older with no ECG for the past 12 months, and for ASA II patients regardless of age

Level 2, Category A

Summary of Evidence

Although patient characteristics carry a more significant impact on pre-operative risk assessment, the type of surgery to be performed is an important consideration in evaluating the potential for perioperative morbidity and mortality. Many of the commonly used risk indices include the type of surgery in estimating overall clinical risk. Surgery related factors that impact the degree of physiologic stress include the level of urgency, degree of invasiveness, type and duration of the procedure.[17] Metabolic and physiologic stress attributable to surgery is directly proportional to the magnitude of the operation, as well as the duration.

The ACC/AHA guidelines on perioperative cardiovascular evaluation and care for non-cardiac surgery stratify procedures by the risk of developing an adverse cardiac event. Depending on the percentage of cardiac risk, procedures are classified as low (≤1%), intermediate (1-5%) or high (≥5%)[18] (Table 4). Procedures that carry a risk of greater than 1% necessitate appropriate pre-operative risk assessment and evaluation in healthy ASA 1 and 2 patients.[2] The NHS-NICE guidelines on routine pre-operative testing provide a simple graded scale to classify the degree of procedural invasiveness[16] (Table 5).

While pre-operative testing for low risk surgeries performed in an ambulatory setting or on an elective basis is not cost-effective and not recommended[19], anticipated prolonged surgical procedures (≥3 hours)

Table 4. Cardiac risk stratification for non-cardiac surgical procedures

High (≥5% cardiac risk)- Emergent major operations, particularly elderly; Aor-tic or major vascular surgery; Peripheral vascular surgery; Upper abdominal

Intermediate (1-5%)- Intraperitoneal and intrathoracic surgery, Carotid endarterectomy, Head and neck surgery, Gynecologic surgery, Neurosurgery, Orthopedic surgery, Urologic surgery

Low (≤1%)- Endoscopic procedures, Superficial procedures, Cataract sur-gery, Breast surgery, Ambulatory surgery

Table adapted from Fleisher LA, Beckman JA, Brown KA, et al. 2009 ACCF/ AHA fo-cused update on peri- operative beta blockade incorporated into the ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac sur-gery: a report of the American College of Cardiology Foundation/American Heart As-sociation task force on practice guidelines. Circulation 2009;120:169-276; and Mukherjee D, Eagle KA. Perioperative cardiac assessment for noncardiac surgery: eight steps to the best possible outcome. Circulation 2003;107:2771-4.

associated with large fluid shifts and/or blood loss that may adversely affect hemodynamic status, cause prolonged operative time due to highly invasive technique (as opposed to minimal access procedures) and those done on an emergent basis, particularly in the elderly, will benefit from diagnostic pre-operative evaluation.[18]

Table 5. Severity of surgical grades.

Grade 1 (minor)- excision of lesion of skin; drainage of breast abscess
Grade 2 (intermediate)- primary repair of inguinal hernia; excision of varicose vein(s) of leg; tonsillectomy/adenotonsillectomy; knee arthroscopy
Grade 3 (major)- Total abdominal hysterectomy; endoscopic resection of prostate; lumbar discectomy; thyroidectomy
Grade 4 (major+)- total joint replacement; lung operations; colonic resection; radi-cal neck dissection; neurosurgery; cardiac surgery

Table adapted from National Institute for Health and Care Excellence (NICE). Routine preopera-tive tests for elective surgery. London (UK): National Institute for Health and Care Excellence (NICE); 2016 Apr 5. 16 p. (NICE guideline; no. 45).

The degree of urgency of a surgical intervention is also important when considering the need for preoperative assessment. In true surgical emergencies such as a ruptured abdominal aortic aneurysm or major vascular trauma, a comprehensive diagnostic evaluation would not be achievable nor would it change the plan of surgery. In such situations, only the most important tests that would influence the immediate plan of management may be requested. In urgent surgical cases, where the complications of the untreated condition outweighs the attendant risk of the surgical procedure, preoperative evaluation can be performed to lower the cardiac risk but by no means alter the surgical plan. In elective procedures, pre-operative assessment is beneficial not only in reducing morbidity and mortality rates, but will be important in treatment planning. Pre-operative assessment helps determine if the patient is a good candidate for surgery, or alternatively, be best managed conservatively.

The type of anesthetic does not factor significantly in the decision to do pre-operative testing because the anesthesiologist must always be ready to shift to general anesthesia should a complication from regional anesthetic procedures arise.[16] However, the depth of anesthesia should be monitored because it may be a risk factor for perioperative complications.[20]

With regard to what type of preoperative tests to request for ASA I and II patients undergoing intermediate to high risk procedures, the following should be considered based on the NICE Guidelines for routine preoperative tests for elective surgery[16]:

- Full blood count- offer the test
- Kidney function tests (creatinine, electrolytes, blood urea nitrogen)- consider for patients at risk for acute kidney injury
- EKG - Consider for people aged over 65 if no ECG results are available from past 12 months

3. Which other risk assess ment tools aside from ASA classification (functional capacity, type of surgery, etc.) is recommended for adult patients for elective non-cardiac surgery?

   ASA is a sufficient tool for preoperative risk assessment.

The following risk assessment tools may also be used to predict perioperative cardiac complications:

- Revised Cardiac Risk Index (RCRI)
- American College of Surgeons-National Surgical Quality Improvement Program (NSQIP)
- Myocardial Infarction or Cardiac Arrest (MICA) Calculator
- ACS NSQIP Surgical Risk Calculator

A validated tool (such as the NRS 2002, SGA, and modified SGA may be used to screen and assess for possible nutrition-related complications

Level III, Category A

Summary of Evidence

Determining the peri-operative risk helps the clinician in deciding if surgery will proceed without any added testing, or if surgery should be postponed, or if the planned surgery should be changed to a procedure of lesser risk. A combination of factors are utilized to estimate peri-operative risk, expressed as a percent likelihood of developing an unexpected event, mostly cardiac in origin.

The risk of developing cardiac complications such as cardiac arrest and myocardial infarction have been reported to be 5% and ranges from 1-5 % for those with intermediate-risk procedures.[11]

All patients deemed to undergo a non-cardiac surgery must be evaluated for peri-operative risk for developing cardiac complications by getting a complete history including symptoms of cardiac diseases like angina, dyspnea ischemic or valvular diseases, congestive heart failure, hypertension, diabetes, kidney disease and cerebrovascular disease together with the functional status of the patient.[11]

Wolters, et al. in 1996 evaluated the ASA classification and peri-operative variables as predictors of outcome by investigating the relationship of the presence of pre-operative risk factors such as hypertension, history of myocardial infarction, smoking and bronchopulmonary diseases, to the development of cardiac and pulmonary complications. They concluded that the risk of complications was significant with ASA Class IV (OR=4.2) and ASA III (OR 2.2).[11]

Several systems of risk assessment have evolved since Goldman in 1977 introduced the first risk assessment tool, the Cardiac Risk Index (CRI), utilizing a point system classification for determining peri-operative risk.[21,22,23,24,25]

Prause, et al. in 1997, in a study of 16,227 patients undergoing non-urgent surgery, correlated peri-operative mortality with ASA physical status classification, Goldman's CRI, and the two combined. They concluded that the combination of ASA Classification and Goldman's CRI can increase the accuracy in predicting peri-operative mortality.[25]

In 1999, Lee did a prospective validation cohort study of 4,315 patients for elective major non cardiac surgery. He revised Goldman's risk assessment tool and introduced the Revised Cardiac Risk Index (RCRI), identifying six independent risk predictors of cardiac complications: high-risk type of surgery, history of ischemic heart disease, history of congestive heart failure, history of cerebrovascular disease, preoperative treatment with insulin and preoperative serum creatinine of >2mg/dL. He concluded that in stable patients undergoing elective major non-cardiac surgery, the RCRI can identify patients at higher risk for complications.[26]

Lee further concluded that the RCRI may be useful in identifying patients who will need further risk stratification, and patients who are at low risk but will need further evaluation by a specialist.[26] Its simplicity has made its application widespread and has been extensively validated.[11,27,28,29]

Ford, et al. in 2009, made a systematic review of 24 cohort studies involving 792,740 patients, evaluating RCRI. He concluded that although RCRI was useful for low risk patients undergoing major non-cardiac surgery, it did not perform well at predicting cardiac events for high risk patients, and those undergoing vascular non-cardiac surgery, or at predicting death.[28]

Gupta, et al. in 2007, evaluated a prospective multicenter cohort study of more than 250 hospitals (n= 211,410 patients) included in the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. Multivariate regression analysis of 136 variables identified 5 predictors for the development of peri-operative myocardial infarction or cardiac arrest (MICA): type of surgery, dependent functional status, abnormal creatinine, American Society of Anesthesiologists (ASA) classification and increasing age. They developed a risk model in 2007 from NSQIP data and validated the results in 2008 (n = 257,385). In 2011, Gupta applied the RCRI to the 2008 NSQIP data, to obtain a better risk model. This was used to develop an interactive risk calculator (MICA risk calculator), a web-based tool, to estimate incidence of postoperative MICA.[29]

In 2013, Bilimoria, et al. developed the American College of Surgeons -NSQIP surgical risk calculator, a web-based tool. They studied 1,414,006 patients in 393

Table 6. Major Cardiac Complication Rates and 95% CIs in Derivation and Validation Cohorts Stratified by Risk Classification System (adapted from: Lee TH, Marcantonio ER, Mangione CM, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major non cardiac surgery. Circulation 1999; 100:1043.)

	Derivation Cohort (n=2893)		Validation Cohort (n=1422)	
	Events/Pop	Rate (95% CI)	Events/Pop	Rate (95% CI)
Original Cardiac Risk Index				
Class I	31/2200	1.4 (1.0, 2.0)	13/1039	1.3 (0.7, 2.1)
Class II	20/561	3.6 (2.2, 5.5)	15/297	5.1 (2.9, 8.2)
Class III	5/127	3.9 (1.3, 8.9)	8/84	9.5 (4.2, 17.9)
Class IV	0/5	0	0/2	0
ROC area (SE)	0.606 (0.034)		0.701 (0.043)	
Modified Cardiac Risk Index				
Class I	49/2786	1.8 (1.3, 2.3)	29/1371	2.1 (1.4, 3.0)
Class II	6/95	6.3 (2.4, 13.2)	4/44	9.1 (2.5, 12.8)
Class III	1/12	8.3 (0.2, 38.5)	3/7	42.9 (9.9, 82)
ROC area (SE)	0.545 (0.022)		0.582 (0.034)	
ASA class				
Class I	0/140	0	0/65	0
Class II	14/1558	0.9 (0.5, 1.5)	7/729	1.0 (0.4, 2.0)
Class III	35/1078	3.3 (2.3, 4.5)	24/561	4.3 (2.8, 6.3)
Class IV	7/81	8.6 (3.5, 17)	4/43	9.3 (2.6, 22.1)
ROC area (SE)	0.697 (0.031)		0.706 (0.036)	
Revised Cardiac Risk Index				
Class I	5/1071	0.5 (0.2, 1.1)	2/488	0.4 (0.05, 1.5)
Class II	14/1106	1.3 (0.7, 2.1)	5/567	0.9 (0.3, 2.1)
Class III	18/506	3.6 (2.1, 5.6)	17/258	6.6 (3.9, 10.3)
Class IV	19/210	9.1 (5.5, 13.8)	12/109	11.0 (5.8, 18.4)
ROC area (SE)	0.759 (0.032)*		0.806 (0.034)†	

*Within the derivation cohort, $P<0.05$ for comparison of performance of Original vs Modified Cardiac Risk Index, Modified Risk Index vs ASA class, and Original Cardiac Risk Index vs ASA class. Also within the derivation cohort, $P<0.001$ for comparison of Revised Cardiac Risk Index vs both Original and Modified Cardiac Risk Index, and $P=0.055$ for comparison of Revised Cardiac Risk Index vs ASA class. Data on ASA class were missing for 36 patients.

†Within the validation cohort, $P=0.021$ for comparison of Revised Cardiac Risk Index vs Original Cardiac Risk Index, $P<0.0001$ for comparison of Revised Cardiac Risk Index vs Modified Cardiac Risk Index, and $P=0.018$ for comparison of Revised Cardiac Risk Index vs ASA class. Data on ASA class were missing for 24 patients.

hospitals encompassing 1,557 unique CPT (Current Procedural Terminology) codes. It included 20 risk factors from demographic data, and co-morbidities plus 1 variable for the type of surgical procedure. The initial data from colon-specific procedures were compared with data from different types of surgery and results were calibrated to come up with a universal model. Furthermore, risk estimate adjustments to the score were allowed to be made by the surgeon, to increase the estimated risk. Results of the study showed this universal NSQIP Surgical Risk Calculator model to be an excellent predictor of mortality (c-statistic = 0.944; Brier score = 0.011), and morbidity (c-statistic = 0.816 , Brier score = 0.069).[30]

The RCRI, MICA and the NSQIP surgical risk calculator, are recommended by the ACA/AHA as validated risk-prediction tools, that can be useful in predicting the risk of peri-operative major adverse cardiac event (MACE) in patients undergoing non-cardiac surgery. The comprehensive nature of the ACS-NSQIP makes it a good risk calculator; its use entails the need for a web browser and an internet connection, and data encoding may be cumbersome. It has not yet been externally validated outside the NSQUIP.[2,11]

A patient who is found to have significant risk for developing cardiac complications must be properly worked up preoperatively with electrocardiogram, echo cardiography or stress testing as deemed necessary with proper referral to a cardiologist.[11]

Preoperative malnutrition is associated with increased morbidity and mortality among patients undergoing major surgical intervention.[31-36] Recently, the ESPEN (European Society for Parenteral and Enteral Nutrition) recommended identifying patients "At Risk"of nutrition related complications using BMI, weight loss and fat free mass index as criteria.[37,38,39]

The ASPEN (American Society for Parenteral and Enteral Nutrition) and the ADA (American Dietetic Association) recommended criteria for the diagnosis of adult malnutrition.based on identification of 2 or more of the following characteristics:[40] (a) insufficient energy intake, (b) weight loss, (c) loss of muscle mass, (d) loss of subcutaneous fat, (e) localized or generalized fluid accumulation that may sometimes mask weight loss, and (f) diminished functional status as measured by hand-grip strength.[40]

There are many nutritional screening and assessment tools used in the surgical population, NRS 2002 (Nutrition Risk Screening 2002)[41] and the SGA (Subjective Global Assessment)[42] have been widely utilized. In the local setting, a validation study using the modified SGA, as advocated by the PhilSPEN (Philippine Society for Parenteral and Enteral Nutrition) and also used by the Committee on Critical Care and Surgical Nutrition in the PCS-IONS (Philippine College of Surgeons -Improved Outcomes with Nutrition Support) back in 2006 and the PSGS (Philippine Society of General Surgeons) Surgical Nutrition Module started in 2011, has been shown to identify complications in "At Risk" surgical and medical patients with a sensitivity of 94.7% and specificity of 95.2%.[43] Ocampo et al., using the surgical nutrition risk assessment form, noted that more complications as the risk score increased,and mortality was noted only in high-risk patients.[44] On the other hand, Del Rosario, et al. showed significantly higher complication rates among surgical patients found to be at high nutrition risk, but no difference in mortality was noted compared to low nutrition risk patients.[45]

References

1. Johansson T, et al. Effectiveness of non-cardiac preoperative testing in non-cardiac elective surgery: a systematic review. Br J Anaesth 2013; 110 (6): 926-39.
2. Fleshier LA, et al. 2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Non-cardiac Surgery. J Am Coll Cardiol 2014; 64(22): e77-137.
3. Halub ME, Sidwell RA. Cardiac risk stratification and protection. Surg Clin N Am 2015; 95: 217-35.
4. Ajimura FY, et al. Preoperative laboratory evaluation of patients aged over 40 years undergoing elective non-cardiac surgery. Sao Paulo Med J 2005; 123(2): 50-3.
5. Stefan DH, et al. the Task Force on Preoperative Evaluation of the Adult Non-cardiac Surgery Patient of the European Society of Anaesthesiology. Pre-operative evaluation of the adult patient undergoing non-cardiac surgery: guidelines from the European Society of Anaesthesiology. Eur J Anaesthesiol 2011;28:684-722.
6. Habib AD, et al. The yield of routine pre-operative cardiovascular evaluation in stable patients scheduled for elective non-cardiac surgery. Int J Cardiol 2015; 186; 325-7.

7. Irum A, Mumtaz K, Muhammad AK. Routine preoperative chest x-ray and its impact on decision making in patients undergoing elective surgical proce-dures. J Ayub Med Coll Abbottabad 2013;25(1-2): 23-5.
8. Isabel AW, et al. Use and utility of hemostatic screening in adults undergoing elective, non-cardiac surgery. PLoS ONE, Dec 2015; 10(12): e0139139. doi:10.1371/journal. pone. 0139139.
9. Garcia AP, et al. Indication of preoperative tests according to clinical criteria: need for supervision. Braz J Anesthesiol 2014; 64(1): 54-61.
10. Fleshier LA, et al. ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Non-cardiac Surgery. J Am Coll Cardiol 2007; 50(17): e159-242.
11. WoltersU, Wolf T, Stutzer H, Schroeder T. ASA classification and perioperative variables as predictors of postoperative outcomes. Br J Anesth 1996; 77: 217-22.
12. Feely MA, et al. Preoperative testing before noncardiac surgery: guidelines and recommendations. Am Fam Physician 2013; 87(6): 414-8.
13. Bock M, et al. The impact of preoperative testing for blood glucose con-centration and haemoglobin A1c on mortality, changes in management and complications in noncardiac elective surgery, A systematic review. Eur J Anaesthesiol 2015; 32: 152-9.
14. 2014 ESC/ESA Guidelines on non-cardiac surgery: cardiovascular as-sessment and management; The Joint Task Force on Non-cardiac Surgery: Cardiovascular Assessment and Management of the European Society of Cardiology (ESC) and the European Society of Anaesthesiology (ESA)
15. Czoski-Murray C, et al. What is the value of routinely testing full blood count, electrolytes and urea, and pulmonary function tests before elective surgery in patients with no apparent clinical indication and in subgroups of patients with common comorbidities: a systematic review of the clinical and cost-effective literature. Health Technology Assessment 2012; 16(50): 1-159.
16. National Institute for Health and Care Excellence (NICE). Routine pre-operative tests for elective surgery. London (UK): National Institute for Health and Care Excellence (NICE); 2016 Apr 5. 16 p. (NICE guideline; no. 45).
17. Fleisher LA, Beckman JA, Brown KA, et al. 2009 ACCF/AHA focused update on perioperative beta blockade incorporated into the ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: a report of the American College of Cardiology Foundation/ American Heart Association task force on practice guidelines. Circulation 2009; 120:169-276; and Mukherjee D, Eagle KA. Perioperative cardiac assessment for noncardiac surgery: eight steps to the best possible outcome. Circulation 2003;107: 2771-4.
18. Sharma GA. Medscape, Preoperative Testing; updated September 16, 2015
19. Petsiti, et al. Depth of anesthesia as a Risk Factor for Perioperative Morbidity; Anesthesiol Res Prac 2015.
20. Halub ME, Sidwell RA. Cardiac risk stratification and protection. Surg Clin N Am 2015; 95: 217-35.
21. Cohn SL, Fleisher LA, Evaluation of cardiac risk prior to non cardiac surgery, www uptodate.com 2016
22. Goldman L. Caldera Dl. Naussbaum et al .Mulifactorialíndex of cardiac risk in non-cardiac surgical procedures . N Engl J Med 1977; 297: 845.
23. Detsky AS. Abrams HB, Forbath N. JR et al. Predicting Cardiac complica-tions in patients undergoing non-cardiac surgery, A multifactorial clinical risk índex. Arch Intern Med 1986; 146; 2131
24. Eagle KA, Coley CM Newell JB, et al .Combining clinical and thallium data optimizes preoperative assessment of cardiac risk before major vascular surgery. Ann Intern Med 1989; 110:859
25. Lee TH, Marcantonio ER, Mangione CM, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. Circulation 1999; 100:1043.
26. Prause G, Ratzenhofer-Comeda B., Pierer G, Smolle-Juttner F, Ganzer H, Smolle J, Can ASA grade or Goldman's Risk índex predict peri-operative mortality. Anesthesia 1997; 52: 206.
27. Deveraux PJ, Goldman L, Cook DJ et al, Perioperative cardiac events in patients undergoing non cardiac surgery : A review of the magnitude of the problems, the pathophysiology of the events and methods to estimate and communicate risk. CMAJ 2005 ; 173:627.
28. Ford MK, Beattie WS, Wijeysundera DN. Systematic review: prediction of perioperative cardiac complications and mortality by the revised cardiac índex . Ann Intern Med 2010 ;152:26.
29. Gupta PK, Gupta H, Sundaram A, et al. Development and validation of a risk calculator for prediction of cardiac risk after surgery. Circulation 2011; 124:381.
30. Bilimoria KY, Liu Y, Paruch JL, et al. Development and evaluation of the universal ACS NSQIP surgical risk calculator: a decision aid and informed consent tool for patients and surgeons. J Am Coll Surg 2013; 217:833.
31. Windsor JA, Hill GL. Weight loss with physiologic impairment. A basic in-dicator of surgical risk. Ann Surg 1988; 207(3): 290-6.
32. Shaw-Stiffel TA, Zarny LA, Pleban WE, Rosman DD, Rudolph RA, Bernstein LH. Effect of nutrition status and other factors on length of hospital stay after major gastrointestinal surgery. Nutrition 1993; 9(2): 140-5.
33. Larsson J, Akerlind I, Permerth J, Hornqvist JO. The relation between nu-tritional state and quality of life in surgical patients. Eur J Surg 1994;160(6e7): 329-34.
34. Sungurtekin H, Sungurtekin U, Balci C, et al. The influence of nutritional status on complications after major intraabdominal surgery. J Am CollNutr 2004; 23(3): 227-32.
35. Bozzetti F, Gavazzi C, Miceli R, et al. Perioperative total parenteral nutrition in malnourished, gastrointestinal cancer patients: a randomized, clinical trial. J Parenter Ent Nutr 2000;24(1): 7-14.

36. Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. Clin Nutr 2003; 22(3): 235-9.
37. Cederholm T, Barazzoni R, Austin P, et al. ESPEN guide Lines on definitions and terminology of clinical nutrition. Clin Nutr 2017; 36(1): 49-64.
38. Cederholm T, Bosaeus I, Barazzoni R, et al. Diagnostic criteria for malnu-trition - an ESPEN consensus statement. Clin Nutr 2015; 34: 335-40.
39. Kondrup J, Rasmussen HH, Hamberg O, Stanga Z; Ad Hoc ESPEN Working Group. Nutritional risk screening (NRS2002): a new method based on an analysis of controlled clinical trials. ClinNutr 2003; 22(3): 321-36.
40. White JV, Guenter P, Jensen G, Malone A, Schofield M; Academy Malnu-trition Work Group.; A.S.P.E.N. Malnutrition Task Force.; A.S.P.E.N. Board of Directors. Consensus statement: Academy of Nutrition and Dietetics and American Society for Parenteral and Enteral Nutrition: characteristics recom-mended for the identification and documentation of adult malnutrition (under-nutrition). J Parenter Enteral Nutr 2012; 36(3): 275-83.
41. Schiesser M, Muller S, Kirchhoff P, et al. Assessment of a novel screening score for nutritional risk in predicting complications gastro-intestinal surgery. Clin Nutr 2008; 27: 565-70.
42. Detsky AS, Mclaughlin JR, Baker JP, et al. What is subjective global as-sessment of nutritional status? J Parenter Enter Nutr 1987;11 (1): 8-13.
43. Lacuesta-Corro L, Paguia G, Lorenzo A et al. The results of the validation process of a Modified SGA (Subjective Global Assessment) Nutrition Assessment and Risk Level Tool designed by the Clinical Nutrition Service of St. Luke's Medical Center, a tertiary care hospital in the Philippines, (Article 12 | POJ_0002.html) Issue February 2012-December 2014: 1-7, http://www.philspenonlinejournal.com/POJ_0002.html. Accessed February 24, 2017.
44. Ocampo RB, Kadatuan Y, Torillo MR, Camarse CM. Predicting post-operative complications based on surgical nutritional risk level using the SNRAF in colon cancer patients - a Chinese General Hospital & Medical Center experience. Phil J Surg Spec 2008; 63(4): 147-53.
45. Del Rosario D. et al. The effect of adequate energy and protein intake on morbidity and mortality in surgical patients nutritionally assessed as high or low risk (Article 9 | POJ_0006.html) Issue January 2010 - January 2012: 67-74, http://www.philspenonlinejournal.com/POJ_0006.html. Accessed February 28, 2017.