Operative risk in elderly patients with cardiovascular dysfunction.

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LIVE

Subtitles

TRADE UNION BILL

# Disclosure

No disclosures related to this talk

Overview

- The Cardiovascular system and the aging Patient

- Clinical and surgical risk factors

- Bio-markers

- Perioperative complications — MACE & MINS

- Risk Reduction Strategies

- Conclusion

Background

- 56,5 million South Africans

- Growing elderly population ≥ 60 years estimated at 8,1 % in 2017

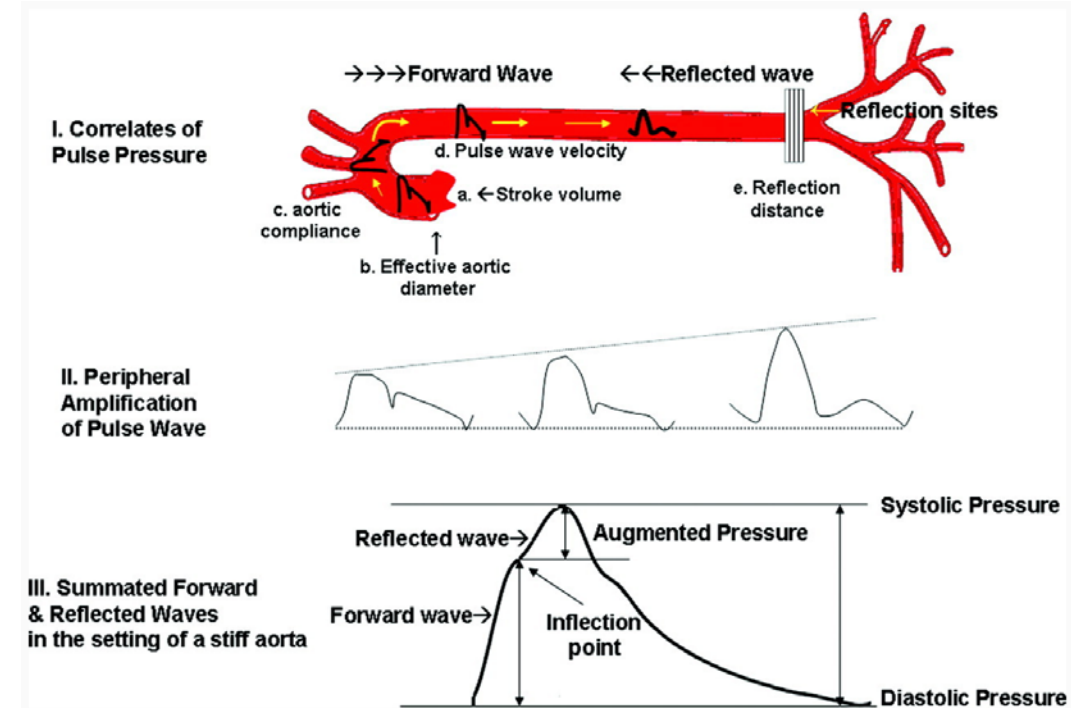- 4,6 million people in SA are estimated to be over the age of 60
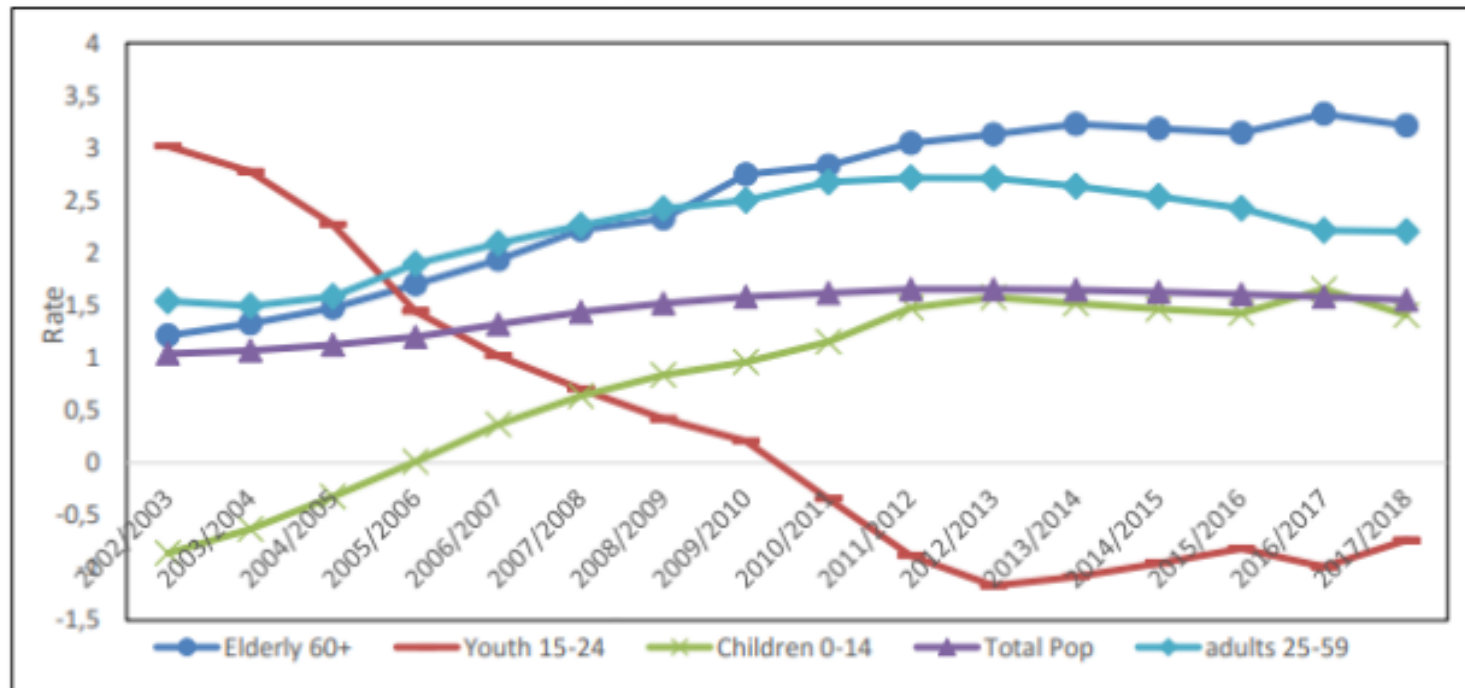
Background

- Older patients are more frail, have multiple comorbidities, and exhibit more severe Coronary Artery Disease(CAD).

- Peri operative Myocardial Infarction(PMI) & Myocardial Injury after Non cardiac Surgery(MINS) is nearly doubled in patients older than 70 years

- Increased risk of procedure-related complications

- Reduced tolerance to operative complications like bleeding & infection

- Age is an independent predictor of cardiac morbidity and mortality

Cardiovascular Changes in the elderly

Systolic hypertension and widened pulse pressure

- Arterial stiffness due to ↑ collagen & ↓ elastin vascular content
- Arteriosclerosis – thickening & hardening of arterial walls
- Aortic pulse wave velocity increases
- Increased systolic pressure & reduced diastolic pressure
- Left ventricular hypertrophy
- Diastolic dysfunction

I. Correlates of Pulse Pressure
→→→Forward Wave   ←←Reflected wave   Reflection sites
d. Pulse wave velocity
c. aortic compliance   a. ←Stroke volume   e. Reflection distance
b. Effective aortic diameter

II. Peripheral Amplification of Pulse Wave

III. Summated Forward & Reflected Waves in the setting of a stiff aorta
Reflected wave→   Augmented Pressure   Systolic Pressure
Forward wave→   Inflection point   Diastolic Pressure

Increased Arterial Stiffness	• Increased central (aortic) SBP • Reduced central (aortic) DBP	Increased central (aortic) Pulse Pressure

SBP= Systolic blood pressure, DBP= Diastolic blood pressure
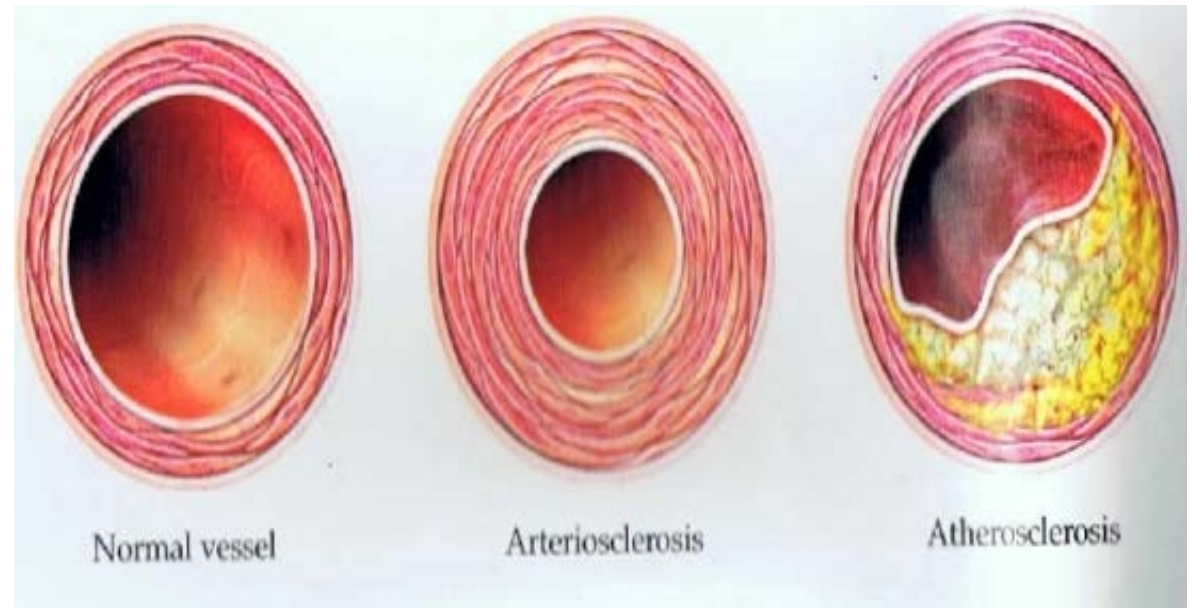
Cardiovascular Changes in the elderly

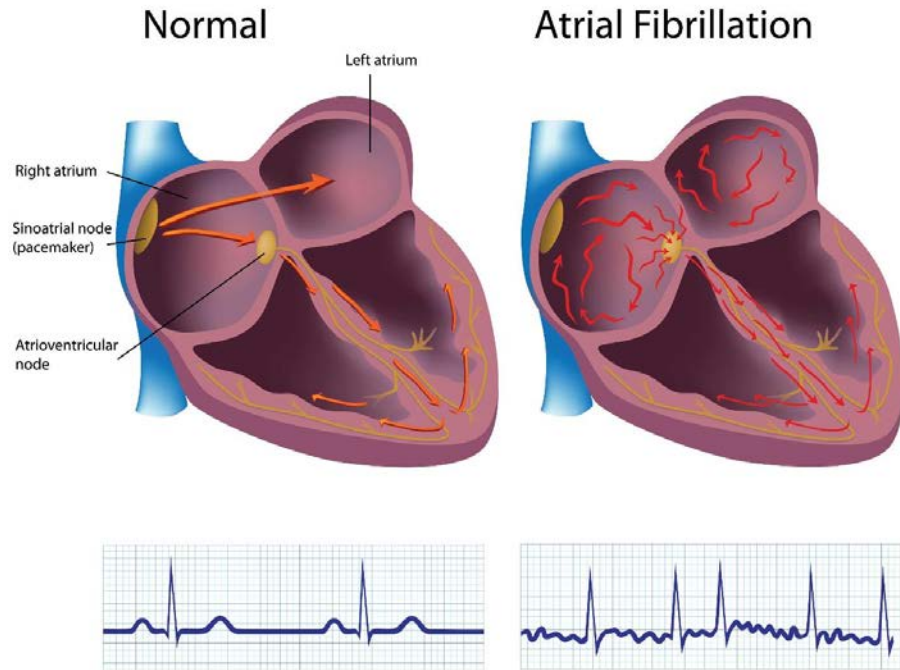- **Atherosclerosis vs Arteriosclerosis**

  - The aging process is associated with a chronic low-grade

    inflammation that predisposes the vasculature to

   o Atherosclerosis and

    o Endothelial dysfunction.

Normal vessel   Arteriosclerosis   Atherosclerosis

Atrial Fibrillation in the elderly

Normal

Left atrium

Right atrium

Sinoatrial node (pacemaker)

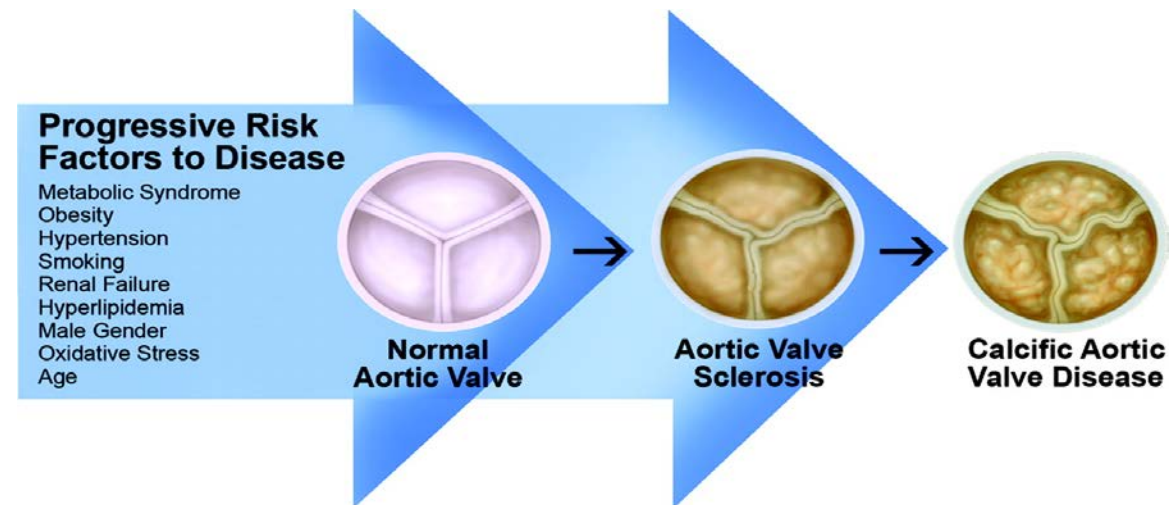Atrioventricular node

Atrial Fibrillation

- Pacemaker cells are progressively lost with advancing age
- **Sick sinus syndrome**.
- This makes **atrial fibrillation** the default rhythm for the elderly.
- **Heart block** and **ventricular ectopy**

Aortic Valve Sclerosis and Stenosis
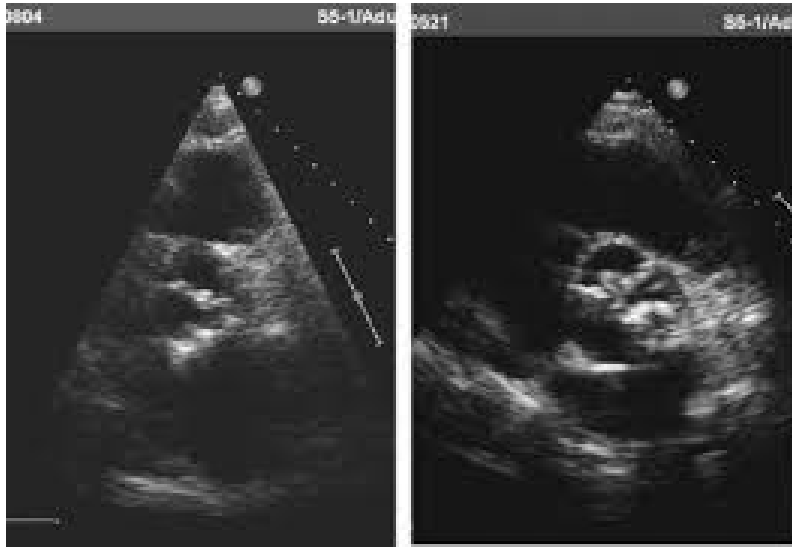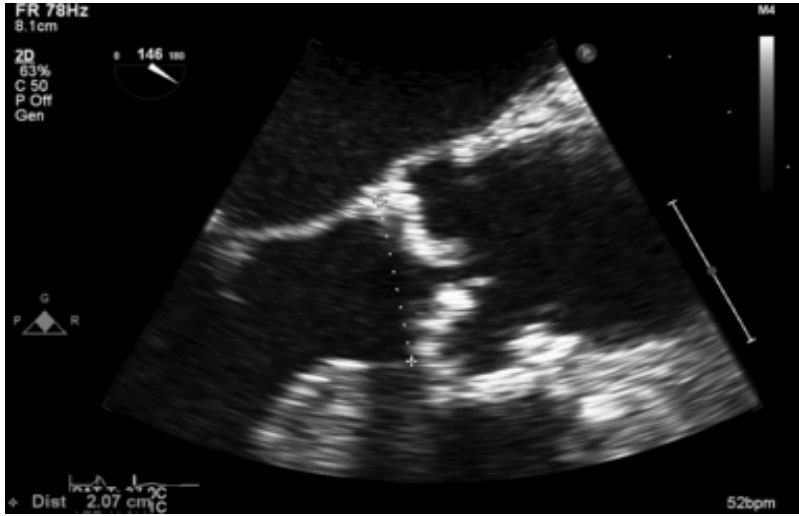
- Prevalence of valvular heart disease (VHD) increases with age
- Degenerative valve disease thought to be the most common VHD in the elderly.
- **Aortic valve (AV) sclerosis** is the most common valvular abnormality associated with increased aging

Progressive Risk Factors to Disease

Metabolic Syndrome
Obesity
Hypertension
Smoking
Renal Failure
Hyperlipidemia
Male Gender
Oxidative Stress
Age

Normal Aortic Valve → Aortic Valve Sclerosis → Calcific Aortic Valve Disease

Pre-Operative Cardiac Risk Assessment

- Clinical risk indices

  o clinical risk factors,

  o surgery-specific risk

  o Exercise capacity

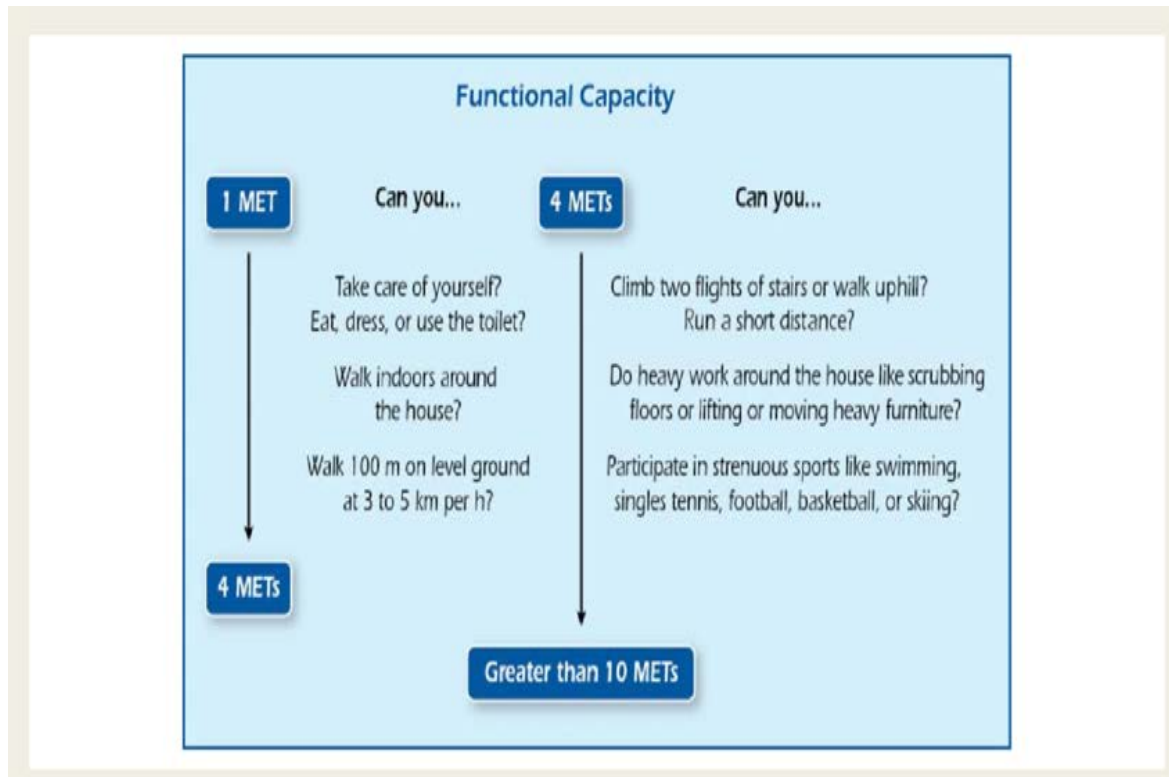- Cardiac Stress Testing

- Cardiac Bio-markers

Functional Capacity

- Exercise tolerance reflects quality of biological age

- One of the most important predictors of perioperative outcome in the elderly surgical patient.

- Expressed in metabolic equivalents (METS)

- Oxygen consumption (Vo_2) approximately 3.5 ml.kg^{-1}.min^{-1}.

Active ageing

Sourav Goswami
Moderator:
Dr Ranjan
Solanki

Functional Capacity

- Patients unable to perform > **4 METS** during most normal daily activities have increased perioperative short-term and long-term cardiac risk.

Functional Capacity

1 MET	Can you...	4 METs	Can you...
	Take care of yourself? Eat, dress, or use the toilet?		Climb two flights of stairs or walk uphill? Run a short distance?
	Walk indoors around the house?		Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?
	Walk 100 m on level ground at 3 to 5 km per h?		Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?
4 METs		Greater than 10 METs	

- **excellent** (>10 METS)

- **good** (7-10 METs)

- **moderate** (4-6 METs)

- **poor** (< 4 METs) or

- **unknown**

Cardiac Stress Testing

- Exercise or pharmacological (dobutamine or dipyridamole)

- Combines information on
  - LV function at rest,
  - heart valve abnormalities, and the
  - presence and extent of stress-inducible ischaemia

- high negative predictive value

- Stress testing is recommended before high-risk surgery, if
  - more than two clinical risk factors and
  - poor functional capacity (<4 METs)

- Testing should only be performed if its results might influence perioperative management.

Clinical Risk Indices

Revised Cardiac Risk Index(RCRI) developed by Lee et al in 1999

Widely & most commonly used/recommended

Six predictors of risk

Cardiac morbidity and death increase with higher scores

Myocardial Infraction and Cardiac Arrest(MICA) Risk Calculator, 2011

Gupta et al, 2007 NSQIP database

>250 hospitals, 211 410 patients

Five (5) predictors of risk

Its predictive value exceeds that of the RCRI

Clinical Risk Indices

ACS NSQIP risk calculator, 2013

A web-based tool consisting of 21 patient-related factors eight surgical procedures

American Society of Anesthesiologists(ASA) Functional Class

Revised Cardiac Risk Index, Lee et al, 1999

Risk Factors	Points
History of ischemic heart disease	1
High-risk type of surgery	1
History of congestive heart failure	1
History of cerebrovascular disease	1
Preoperative treatment with insulin	1
Preoperative serum creatinine >2.0 mg/dL	1

RISK OF MAJOR CARDIAC EVENT

Points	Class	Risk
0	I	0.4%
1	II	0.9%
2	III	6.6%
3 or more	IV	11%

Major
- Recent myocardial infarction (<30d)
- Unstable or severe angina
- Decompensated congestive heart failure
- High-grade atrioventricular block
- Symptomatic ventricular arrhythmias in the presence of underlying heart disease
- Supraventricular arrhythmias with uncontrolled ventricular rate
- Severe valvular disease

Intermediate
- Mild angina pectoris
- Prior myocardial infarction by history or pathological Q waves
- Compensated or prior congestive heart failure
- Diabetes mellitus

Minor
- Advanced age
- Abnormal ECG
- Rhythm other than sinus
- Low functional capacity
- History of stroke
- Uncontrolled systemic hypertension

National Surgical Quality Improvement Program(NSQIP)

- Developed to assess the risk of intraoperative/postoperative myocardial infarction or cardiac arrest,

- Using the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database

Myocardial Infarction or Cardiac Arrest risk Prediction Calculator(MICA)

- Type of surgery

- Functional status

- Abnormal creatinine

- American Society of anaesthesiologists Class

- Increasing age

- The MICA risk calculator is available at www.surgicalriskcalculator.com

Cardiovascular Surgery

Development and Validation of a Risk Calculator for Prediction of Cardiac Risk After Surgery

Prateek K. Gupta, MD; Himani Gupta, MD; Abhishek Sundaram, MBBS, MPH; Manu Kaushik, MD;
Xiang Fang, PhD; Weldon J. Miller, MS; Dennis J. Esterbrooks, MD; Claire B. Hunter, MD;
Iraklis I. Pipinos, MD; Jason M. Johanning, MD; Thomas G. Lynch, MD; R. Armour Forse, MD, PhD;
Syed M. Mohiuddin, MD; Aryan N. Mooss, MD

Guidelines

Canadian Cardiovascular Society Guidelines, 2017

ACC/AHA, 2014

**European Society of Cardiology ESC/ESA, 2014**

Cardiac biomarkers

- Natriuretic Peptides

  o Brain natriuretic peptides (BNPs) and

  o N-terminal fragment of proBNP (NT-proBNP)

- Highly-sensitive(hs) Troponin T

Cardiac Biomarkers —BNP/NT-proBMP

- Natriuretic Peptides(NP)
  - Brain Natriuretic Peptide(BNP)
  - N-terminal of proBNP(NT-proBNP)

- Released from cardiomyocytes in response to
  - ischemia
  - myocardial stretch, etc

- Thresholds ass. with increased cardiovascular complications
  - BMP > 92 ng/ml
  - NT-proBNP > 300 ng/ml

- When added to clinical risk indices, BNP & pro-BNP increase the predictive ability for mortality, MI & heart failure, Rodseth et al (1)


1. J Am Coll Cardiol 2011;58:522–9.

Biomarkers
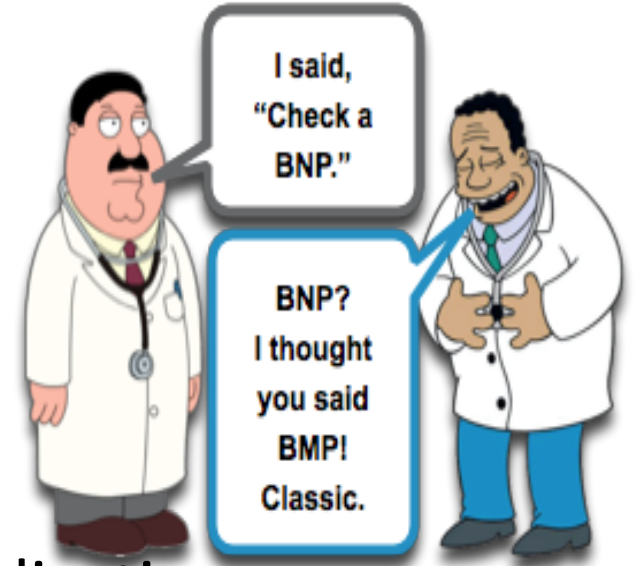
The Predictive Ability of Pre-Operative B-Type Natriuretic Peptide in Vascular Patients for Major Adverse Cardiac Events

An Individual Patient Data Meta-Analysis

- If the RCRI is ≥1, the patient's age is ≥65 with significant cardiac disease, the next step is to measure the patient's NT-ProBNP or BNP

- If the **NT-ProBNP is ≥300 ng/l** or **BNP is ≥92 ng/l**, then there should be an EKG ordered and troponins should be measured daily for 48-72 hours.

Cardiac Bio-makers – hs Troponin T
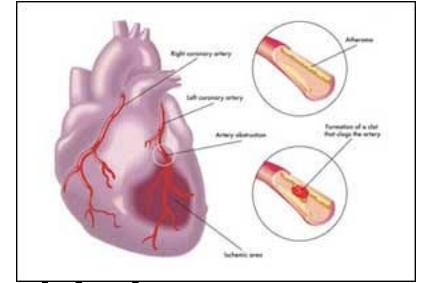
- Increased levels of TnT indicate the presence of myocardial injury

- Ability to identify patients with PMI even in the absence of symptoms or ECG changes

- high sensitivity for detection of small amounts of myocardial necrosis

- Peak levels > 0.03 ng/ml are diagnostic of myocardial injury after non-cardiac surgery (MINS) — increased 30 day mortality

Preoperative Risk Stratification, BNP, cTnT
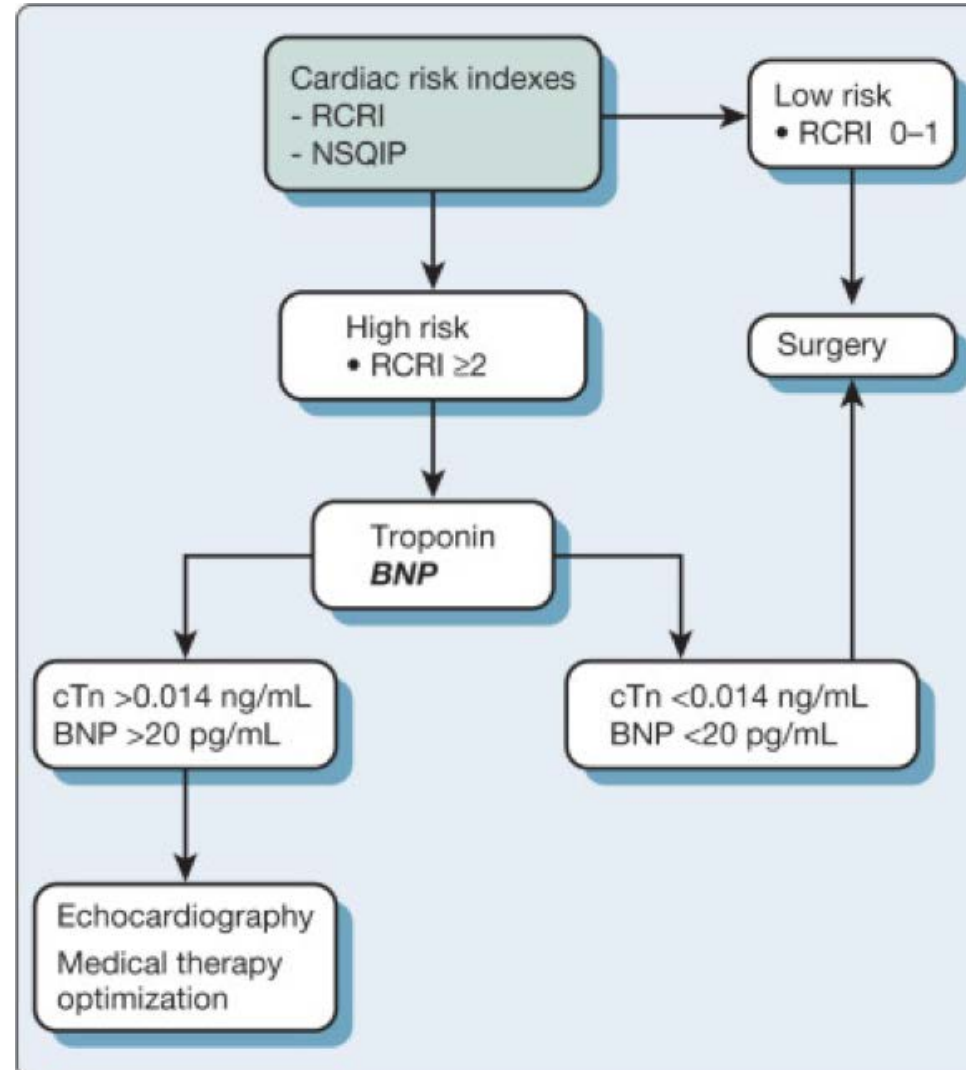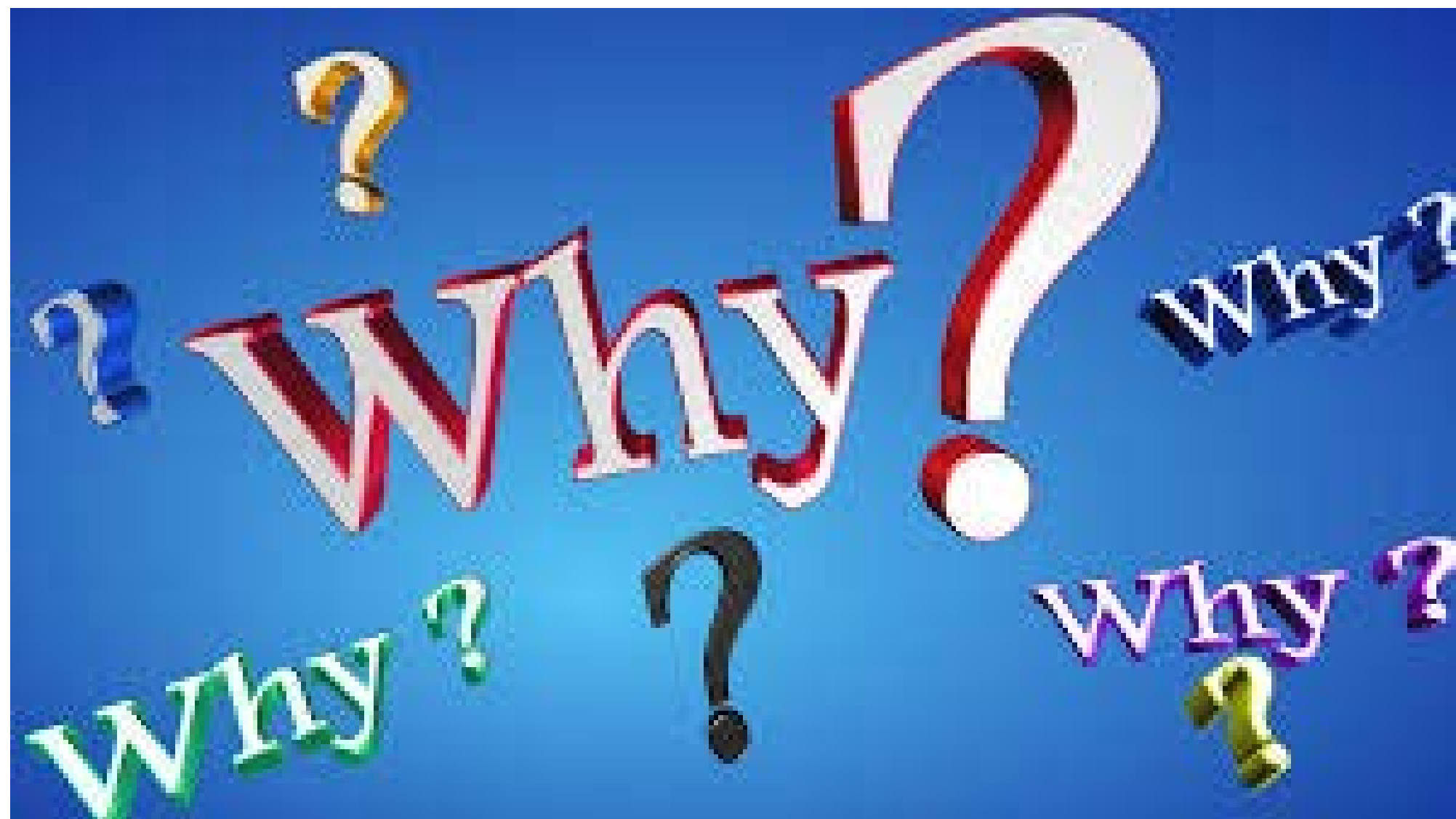
Cardiac Morbidity and Mobility

- MACE – Major adverse cardiac events

  - **Non-fatal Perioperative Myocardial Infarction(PMI)**

  - **Myocardial Injury after Non cardiac Surgery(MINS)**

  - Congestive cardiac failure

  - Cerebrovascular accident

  - Cardiac Death

MINS – myocardial injury after non-cardiac surgery

- an elevation of postoperative troponin with an ischemic origin without other criteria for myocardial infarction

Perioperative Myocardial Infarction(PMI)

- Myocardial Oxygen Supply-Demand Imbalance

- Stable coronary plaque

- Prolonged ST-segment depression

  - Tachycardia & Hypertension

  - Hypotention

  - Pain

  - Anemia

  - Hypoxaemia

  - Hypercoaguability
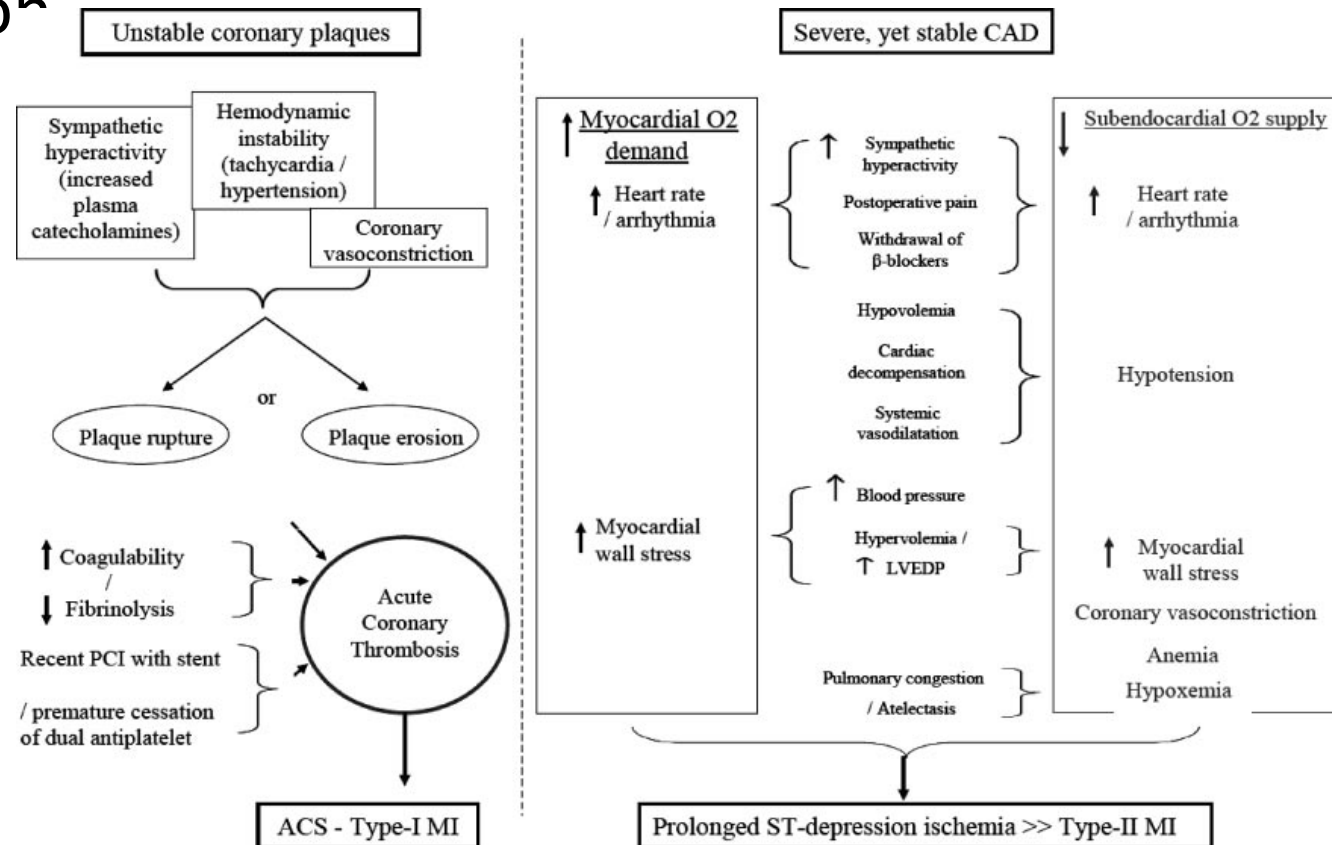
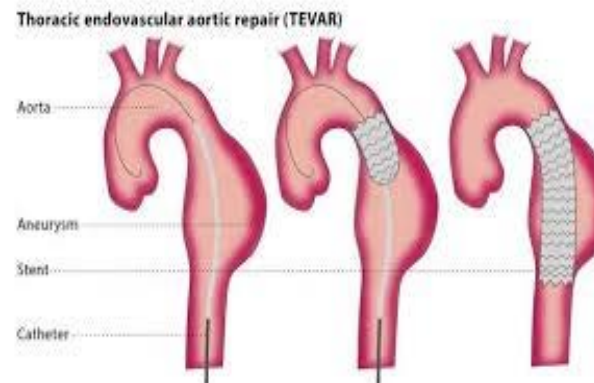# Risk Reduction Strategies

Operative

- Open/operative/invasive

Minimally invasive

- Endoscopic
- Laparoscopic
- Thoracoscopic
- Endovascular

Thoracic endovascular aortic repair (TEVAR)

Aorta
Aneurysm
Stent
Catheter

Risk Reduction Strategies

Medical Optimization

β-Blockers

Continuation of beta-blockers peri-operatively in patients on long-term beta-blocker therapy

Class I recommendation

Statins

Patients already on statin therapy long term should continue statin therapy perioperatively

Class I recommendation

Aspirin

ASA should be stopped a minimum of 3 days (median 7) before surgery.

Angiotensin Converting Enzyme(ACE)-Inhibitors

Should be stopped 24 hrs prior to surgery reduce risk of intraoperative hypotension which is an independent intraoperative predictor for MACE

Risk Reduction Strategies

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Class I recommendation

Avoid hypotension & bradycardia

Start 30 days pre-op(ideally)

Heart rate 60 – 70 beats/min

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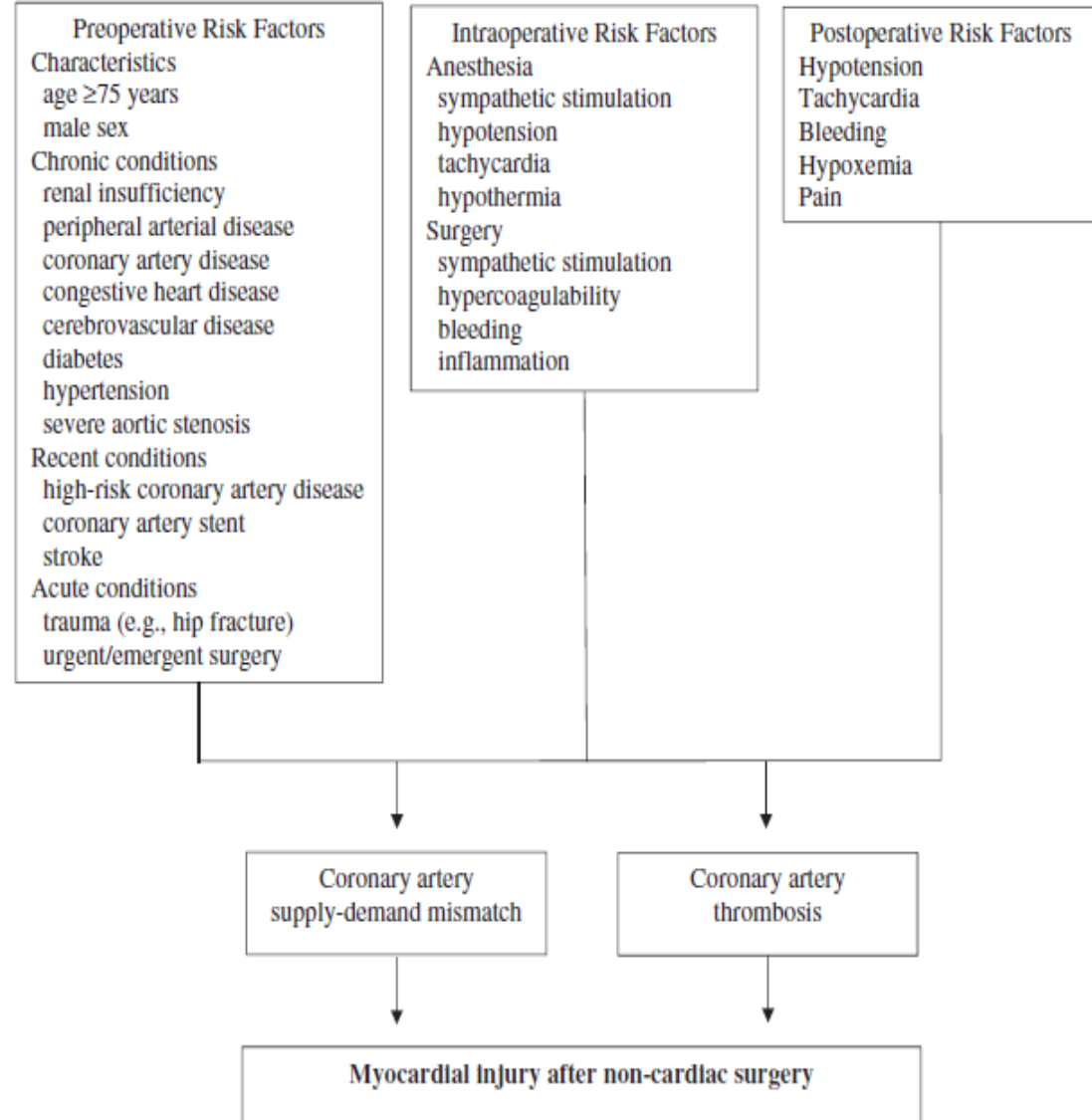
- Avoid/treat:

  o Hypotension

  o Tachycardia

  o Bleeding

  o Hypothermia

  o Pain

  o Hypoxaemia

Preoperative Risk Factors
Characteristics
  age ≥75 years
  male sex
Chronic conditions
  renal insufficiency
  peripheral arterial disease
  coronary artery disease
  congestive heart disease
  cerebrovascular disease
  diabetes
  hypertension
  severe aortic stenosis
Recent conditions
  high-risk coronary artery disease
  coronary artery stent
  stroke
Acute conditions
  trauma (e.g., hip fracture)
  urgent/emergent surgery

Intraoperative Risk Factors
Anesthesia
  sympathetic stimulation
  hypotension
  tachycardia
  hypothermia
Surgery
  sympathetic stimulation
  hypercoagulability
  bleeding
  inflammation

Postoperative Risk Factors
Hypotension
Tachycardia
Bleeding
Hypoxemia
Pain

Coronary artery
supply-demand mismatch

Coronary artery
thrombosis

Myocardial injury after non-cardiac surgery

Conclusion

- Elderly patients tend to accumulate more severe cormorbidities

- Age is an important risk predictor for major cardiac adverse outcomes

- Functionally independent patients have less risk for complications

- Clinical risk indices are available, but have their limitations

- Biomakers increase the predictive ability of clinical risk indices, but come with a cost