

Ischemic heart diseases / شذی کاظم عطره/ ت. تخدير م. ثلاثة 2023-2024

Overview

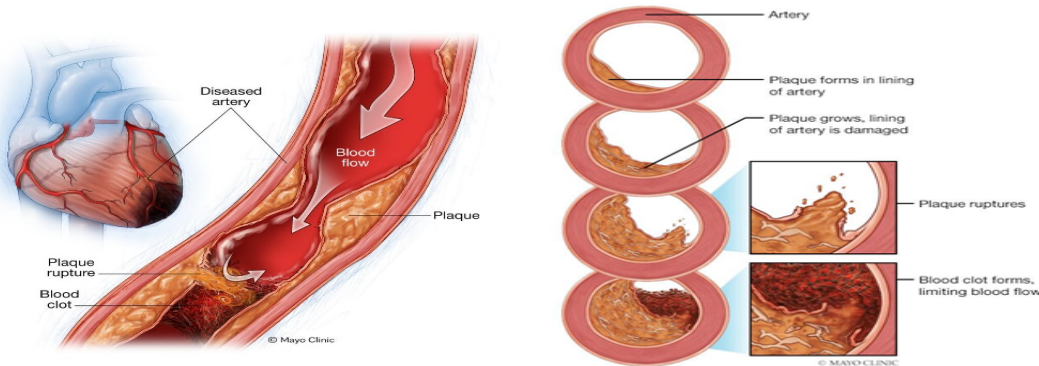
Myocardial ischemia **occurs** when blood flow to your heart is reduced, **preventing** the heart muscle from receiving enough oxygen. The **reduced blood flow** is usually the result of a partial or complete blockage of your heart's arteries (**coronary arteries**).

A **sudden, severe blockage** of one of the heart's artery can lead to a **heart attack**. Myocardial ischemia might also **cause serious abnormal heart rhythms**.

Treatment for myocardial ischemia **involves improving blood flow to the heart muscle**. **Treatment** may **include** (1) **medications**, (2) a **procedure to open blocked arteries (angioplasty)** or (3) **bypass surgery**.

Making **heart-healthy lifestyle choices** is **important in *treating and **preventing myocardial ischemia**.

Ischemic heart disease **refers** to heart weakening **caused** by reduced blood flow to your heart. **Typically**, this reduced blood flow **is the result of coronary artery disease**, a **condition** that occurs when your **coronary arteries narrow**. **Ischemic heart disease** may also be called “**cardiac ischemia**” or “**ischemic cardiomyopathy**”.



Symptoms

Some people who have myocardial ischemia **don't have any signs or symptoms (silent ischemia)**.

When they do occur, the most common is chest pressure or pain, typically on the left side of the body (angina pectoris). Other signs and symptoms — which might be experienced more commonly by women, older people and people with diabetes — **include**:

1. Neck or jaw pain
2. Shoulder or arm pain
3. A fast heartbeat
4. Shortness of breath when you are physically active
5. Nausea and vomiting
6. Sweating
7. Fatigue

Causes

Myocardial ischemia **occurs** when the **blood flow through one or more of your coronary arteries is decreased**. The **low blood flow decreases the amount of oxygen** your heart muscle receives.

Myocardial ischemia can ***develop slowly** as arteries become **blocked over time**. Or it can **** occur quickly** when an artery becomes **blocked suddenly**.

Conditions that can cause myocardial ischemia **include**:

1. **Coronary artery disease (atherosclerosis).** Plaques made up mostly of cholesterol build up on your artery walls and restrict blood flow. Atherosclerosis is the **most common cause** of myocardial ischemia.
2. **Blood clot.** The plaques that develop in atherosclerosis can rupture, causing a blood clot. The clot might block an artery and lead to sudden, severe myocardial ischemia, resulting in a heart attack. Rarely, a blood clot might travel to the coronary artery from elsewhere in the body.
3. **Coronary artery spasm.** This temporary tightening of the muscles in the artery wall can briefly decrease or even prevent blood flow to part of the heart muscle. Coronary artery spasm is an uncommon cause of myocardial ischemia.

Development of atherosclerosis

If there's too much cholesterol in the blood, the cholesterol and other substances may form deposits (plaques) that collect on artery walls. Plaques can cause an artery to become *narrowed or *blocked. If a plaque ruptures, a blood clot can form. Plaques and blood clots can reduce blood flow through an artery.

Chest pain associated with myocardial ischemia can be triggered by:

1. Physical exertion
2. Emotional stress
3. Cold temperatures
4. Cocaine use
5. Eating a heavy or large meal
6. Sexual intercourse

Risk factors

Factors that can increase your risk of developing myocardial ischemia include:

1. **Tobacco.** Smoking and long-term exposure to secondhand smoke can damage the inside walls of arteries. The damage can allow deposits of cholesterol and other substances to collect and slow blood flow in the coronary arteries. Smoking causes the coronary arteries to spasm and may also increase the risk of blood clots.
2. **Diabetes.** Type 1 and type 2 diabetes are linked to an increased risk of myocardial ischemia, heart attack and other heart problems.
3. **High blood pressure.** Over time, high blood pressure can accelerate atherosclerosis, resulting in damage to the coronary arteries.
4. **High blood cholesterol level.** Cholesterol is a major part of the deposits that can narrow your coronary arteries. A high level of "bad" (low-density lipoprotein, or LDL) cholesterol in your blood may be due to an inherited condition or a diet high in saturated fats and cholesterol.
5. **High blood triglyceride level.** Triglycerides, another type of blood fat, also may contribute to atherosclerosis.
6. **Obesity.** Obesity is associated with diabetes, high blood pressure and high blood cholesterol levels.
7. **Waist circumference.** A waist measurement of more than 35 inches (89 centimeters) for women and 40 inches (102 cm) in men increases the risk of high blood pressure, diabetes, and heart disease.
8. **Lack of physical activity.** Not getting enough exercise contributes to obesity and is linked to higher cholesterol and triglyceride levels. People who get regular aerobic exercise have better heart health, which is associated with a lower risk of myocardial ischemia and heart attack. Exercise also reduces blood pressure.

Complications

Myocardial ischemia can lead to serious complications, including:

1. **Heart attack.** If a coronary artery becomes completely blocked, the lack of blood and oxygen can lead to a heart attack that destroys part of the heart muscle. The damage can be serious and sometimes fatal.
2. **Irregular heart rhythm (arrhythmia).** An abnormal heart rhythm can weaken your heart and may be life-threatening.
3. **Heart failure.** Over time, repeated episodes of ischemia may lead to heart failure.

Prevention

The same **lifestyle habits** that **can help treat** myocardial ischemia can also **help prevent it** from developing in the first place. Leading a heart-healthy lifestyle can **help keep your arteries strong, elastic and smooth**, and allow for **maximum blood flow**.

IHD & **Administering anaesthesia**

Administering anaesthesia to patients with **preexisting cardiac disease** is an interesting **challenge**.

Most common **cause** of **peri-operative morbidity** and **mortality** in cardiac patients is **ischemic heart disease (IHD)**.

IHD is number **one cause** of **morbidity** and **mortality** all over the world.

Care of these patients **require**:

1. **Identification of risk factors**,
2. **Pre-operative evaluation & optimization**,
3. **Medical therapy, monitoring**
4. **The choice of appropriate anaesthetic *technique and *drugs.**

Risk factors: Influencing perioperative cardiac **morbidity** are:

- i. Recent myocardial infarction
- ii. Congestive cardiac failure
- iii. Peripheral vascular disease
- iv. Angina pectoris
- v. Diabetes mellitus
- vi. Hypertension
- vii. Hypercholesterolemia
- viii. Dysrhythmias
- ix. Age
- x. Renal dysfunction
- xi. Obesity
- xii. Life style and smoking

Evaluation: Patients having **any sort of cardiac** ailment need to **be evaluated properly preoperatively**.

History: History elicits the **severity, progression** and **functional limitation** introduced by cardiac disease.

History should include:-

1. **Exercise tolerance**:- It depicts **cardiac reserve**. It can be **Excellent** -history of **participation** in **sports** like swimming, football, tennis, basket-ball, skating etc. **Adequate-patient** able to climb stairs, run a short distance. **Poor-** able to do **leisure activities** only e.g. slow ballroom dancing or can walk around in the house only.
2. **Angina pectoris**:-It is the symptomatic manifestation of **myocardial ischaemia** characterized by typical "sub sternal pain" which is evoked by "physical exertion" and relieved by "rest" or "sublingual nitroglycerine".
3. **Myocardial infarction**:- The **incidence of myocardial infarction during the perioperative period** is related to **time period since the previous myocardial infarction**. According to Tarhan et al - incidence of **peri-operative re-infarction is 37%** if the time elapsed is less than 3 months, while **16%** when time elapsed is 4-6 months and **5%** when time elapsed is more than 6 months. This is the basis for recommendation to wait for 6 months after MI for elective major surgery.
4. **Co-existing non-cardiac diseases**
 - i. **Peripheral vascular disease**
 - ii. **Cerebrovascular disease**
 - iii. **Chronic obstructive pulmonary disease** in patients with history of cigarette smoking
 - iv. **Renal dysfunction** may be associated with chronic hyper-tension
 - v. **Diabetes**- May be the cause of **silent MI** [SUPPORTING:1]
 - vi. **Anaemia, polycythemia, thrombocytosis** when present will need careful management.

5. **Current medications**-Awareness about the **medications** that patient is taking is **important during anaesthesia**. All cardiac medications like **beta blockers, calcium channel blockers, nitrates** should be **continued until** the morning of surgery. Patient may be on **oral anticoagulants** or **aspirin** which should be **stopped 5-7 days** prior to surgery.

6. **Congestive cardiac failure**:-The stress of *anaesthesia, *surgery and *fluid replacement may **result** in **overt failure** in patients bordering on congestive heart failure.

7. **Dysrhythmias.**

Quizzes:

Is anesthesia not given to heart patients? Why?

*In the patient with pre-existing cardiac disease, these **cardiovascular anesthetic effects** **become** much more serious. These patients will **not tolerate wide swings of hemodynamic variables**, and the **cardio-depressant effects** of anesthetics are more pronounced in them **أكثر وضوحاً فيهم**.

***Induction** of anesthesia in patients with ischemic heart disease **can be accomplished** with an intravenous induction drug. **Ketamine is not a likely choice** because the associated increase in *heart rate and *systemic blood pressure **transiently increases myocardial oxygen requirements**.

What **type of anesthetic is used** for a patient with a history of heart disease?

Clinical studies, in cardiac surgery, have demonstrated that **propofol**, in association with an **opioid**, is a logical **anaesthetic choice**.

The **Revised Cardiac Risk Index (RCRI)** is a popular "classification system" to estimate patients' risk of postoperative cardiac complications based on **preoperative risk factors**. *Renal impairment, defined as serum creatinine >2.0 mg/dL (177 µmol/L), is a component of the RCRI.

Class	Points	Predicted Cardiac Events (%)
I	0	0.4
II	1	0.9
III	2	6.6
IV	≥ 3	11

REVISED CARDIAC RISK INDEX

6 independent predictors

- High risk surgery
- Ischemic heart disease
- Heart failure
- Cerebro-vascular disease
- Pre-op treatment with insulin
- Pre-op Cr over 2 mg/dl

Rate of major cardiac complications-

- 0 – 0.5 % 1- 1.3%
- 2 – 4% >3 – 9 %

TABLE 1

Revised Cardiac Risk Index⁷

Two or more of the following risk factors make a patient "high risk."

- High-risk surgery (intra-peritoneal, intrathoracic, or supra-inguinal vascular procedures)
- History of ischemic heart disease
- History of congestive heart failure
- History of cerebrovascular disease
- Preoperative treatment with insulin
- Preoperative serum creatinine >2.0 mg/dL

- High-risk surgery (intra-thoracic, intra-peritoneal or suprainguinal vascular surgery)
- Coronary artery disease
- Chronic heart failure
- Cerebrovascular disease
- Diabetes on insulin
- Creatinine levels > 2.0mg/dL

Examination

- A careful **general physical examination** should be done. It should **include** **assessment of vital signs** like blood pressure, pulse rate and rhythm, jugular venous pulse, oedema, pallor, cyanosis, clubbing, jaundice, lym-phadenopathy.
- In **systemic examination**, cardiovascular system should be examined for **heart sounds & any murmur**.
- Further evaluation** is needed as per the findings. **Respiratory system** also needs to be **assessed** in details.

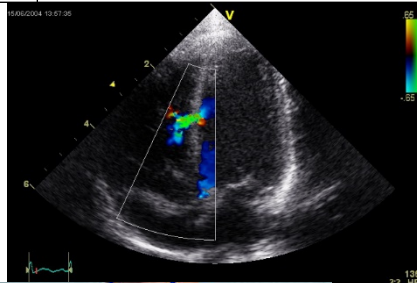
Laboratory investigations

Cardiac specific tests like ECG, echocardiography to know ***ejection fraction**, any ***valvular lesion**, ***wall motion** abnormalities, ***LV function** and **pressure gradients**,

Holter monitoring, **Treadmill test**, **thallium scintigraphy** to **detect** **myocardium at risk**, **radionuclide ventriculography**, **dobutamine stress test (DST)** for **evaluating** **inducible ischemia** in patients who have poor functional capacity, **coronary angiography** in patients where DST is positive should be done.

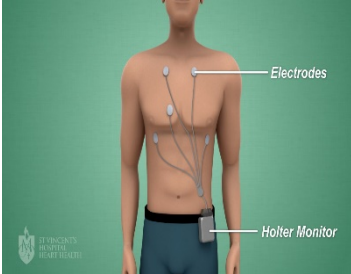
Test	Definition
echocardiography	or "echo", is a scan used to look at the heart and nearby blood vessels. It's a type of ultrasound scan, which means a small probe is used to send out high-frequency sound waves that create echoes when they bounce off different parts of the body
Holter monitoring	It involves the use of a portable external monitor worn by means of a strap around the waist or over the shoulder that measures and records the heart electrical impulses on a tape. The monitor is equipped with a clock that permits accurate time monitoring

Treadmill test	In a stress test , patient walk on a treadmill that makes the heart work progressively harder. An electrocardiogram (ECG) monitors your heart's electrical rhythms. The doctor also measures your blood pressure and monitors whether you have symptoms like chest discomfort or fatigue. ١٥
thallium scintigraphy	Or cardiolite) scan uses a radioactive tracer to see how much blood is reaching different parts of your heart. These tests are the more common forms of tests called nuclear medicine scans . You may also hear them called: thallium myocardial imaging
radionuclide ven-triculography	(RNV) scan is a non-invasive way of assessing the ventricular function and intracardiac hemodynamics . It assesses the ventricular systolic function precisely with less interobserver variability تباين بين المراقبين
dobutamine stress test(DST)	During a dobutamine stress test , you receive a medication called dobutamine , which stimulates your heart just like exercise does. This test allows healthcare providers to see how your heart works under the stress of physical activity . A dobutamine stress test can show: Problems with your heart muscle or valves.



Stress ECHOCardiography

- Dynamic evaluation of cardiac structure & function during physical exercise or pharmacologic simulation of exercise by increased HR, CO & myocardial oxygen demand
- Stress echocardiographic imaging techniques may be used to evaluate for myocardial ischemia, viability & valvular dysfunction



What to expect during a cardiac stress test.

- 1** Vitals are taken at rest.
- 2** Begin walking on treadmill.
- 3** Vitals are recorded every 3 minutes as treadmill intensity increases. **3 MIN**
- 4** Exercise until reaching or nearing maximum heart rate.
- 5** You can slow down now. Gradually cool down.

Cleveland Clinic

Understanding Your Nuclear Medicine Stress Test

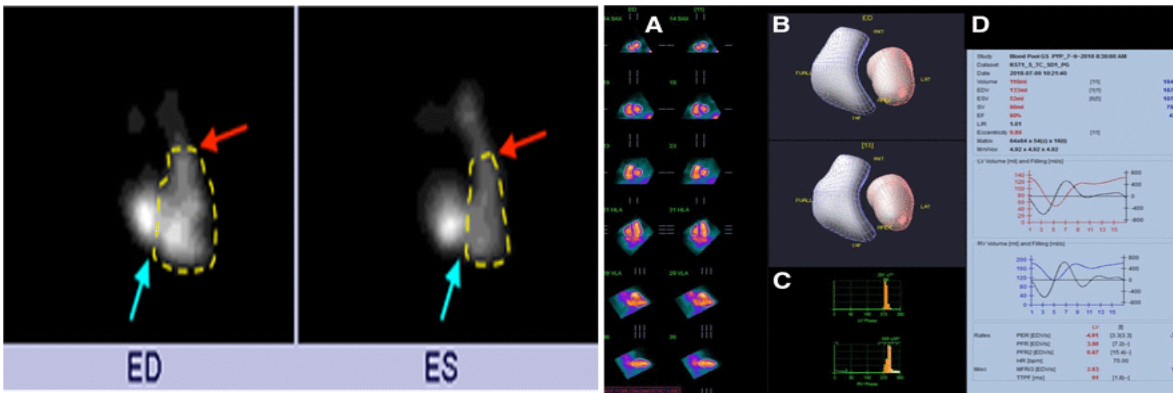
SHORT AXIS HORIZONTAL LONG AXIS VERTICAL LONG AXIS

NORMAL ABNORMAL ABNORMAL

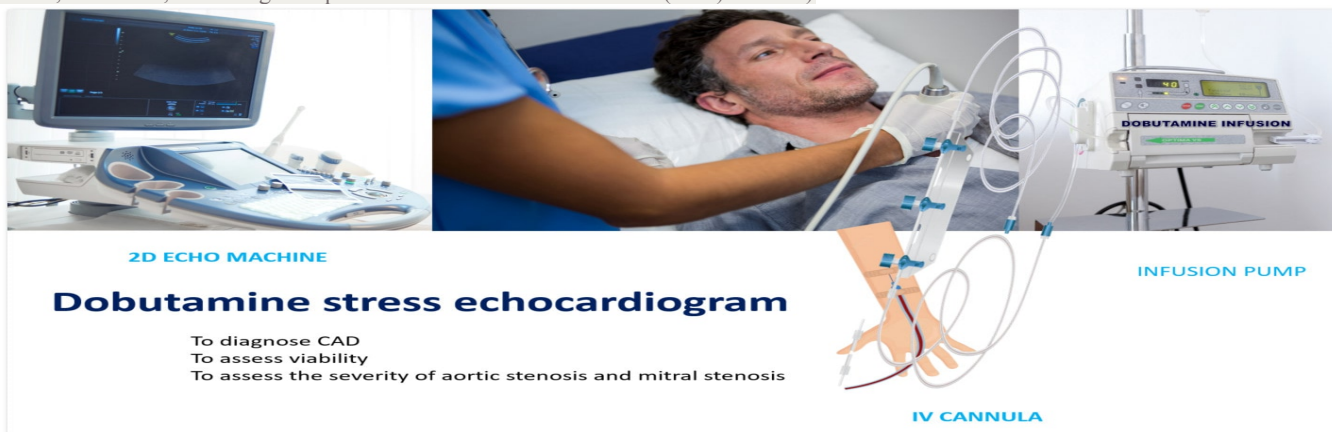
1. PAREN 10/17 AT WWW.DIGIRAD.COM

The radiotracer, injected into a vein, emits gamma radiation as it decays. A gamma camera scans the radiation area and creates an image.





Right ventricular functional analysis utilizing first pass Ventricular function data from SPECT ERNA. SPECT ERNA data depicting end-diastolic and end-systolic contours (A), 3-dimensional rendering of LV and RV walls and morphology (B), phase data (C), and volumetric data for both ventricles (left in red and right in blue) (D). (Image courtesy of Ronald G. Schwartz, MD, University of Rochester Medical Center, Rochester, NY. Images acquired on a cadmium-zinc-telluride (CZT) camera.)



Anaesthetic management

Anaesthesia **goals** remain

- i. **Stable hemodynamics**
- ii. **Prevent MI by optimizing myocardial oxygen supply and reducing oxygen demand**
- iii. Monitor for **ischemia**
- iv. Treat **ischemia** or **infarction** if it develops
- v. **Normothermia**
- vi. Avoidance of significant **anaemia**

Management depends upon the **type of surgery** whether ***emergency** or ***elective**.

For **emergency surgery** proceed **قديما** for the **surgery** with medical management of **cardiac ailment** **مرض قلبي**.

For **elective surgery** perioperative management **depends upon** various 1) **clinical risk factors** and 2) **surgery specific** risk factors.

Clinical risk factors

Obtained by ***history**, ***physical examination** & ***review of ECG**, the ***clinical risk factors** are **grouped into 3 categories-**

1. **Major clinical predictors** are ***unstable coronary syndrome**, ****decompensated heart failure**, *****significant dysrhythmia** and ******severe valvular disease**. They **mandate** **تفويض** **intensive management** even if that leads to delay or cancellation **except emergency surgery**.
2. **Intermediate clinical predictors** are ***mild angina pectoris**, ****previous MI by history or pathological Q waves**, *****compensated or prior heart failure**, ******insulin dependent diabetes mellitus**, and ******renal insufficiency**. These are **markers** of **enhanced risk of** **زيادة خطر** **peri-operative cardiac complications**. It appears reasonable to **wait** for 4-6 weeks **after MI** for **elective surgery**.

3. **Minor clinical predictors** are *hypertension, **LBBB, ***nonspecific ST-T wave changes and ****history of stroke. They have **not proved to increase risk** independently.

Surgery specific risk factors

1. **High risk surgeries**- (emergent major operations particularly in the *elderly, **aortic and other major vascular surgery, ***anticipated prolonged surgical procedures associated with large fluid shifts or anticipated blood loss) are often **reported to have a cardiac risk** of greater than **5%**.
2. **Intermediate risk surgeries**- (carotid Endarterectomy, head and neck surgery, intraperitoneal and intrathoracic surgery, prostate surgery) are reported generally to **have cardiac risk of less than 5%**.
3. **Low risk procedures**:- (endoscopic procedures, superficial procedures, cataract surgeries, breast surgery) are reported to have less than **1%** risk of cardiac events.

Preoperative management

At risk patients need to be **managed with pharmacologic** and other **perioperative interventions** that can ameliorate تحسين perioperative “cardiac events”.

Three therapeutic options are available before **elective noncardiac surgery**:-

1. **Optimization** of medical management
2. **Revascularization by PCI**, revascularization by surgery (CABG)

Note: **Coronary revascularization** typically refers to **two specific procedures**: a. Percutaneous coronary intervention (PCI). This is a minimally-invasive procedure that restores blood flow from the inside. b. Coronary artery bypass grafting (CABG).

However it may not be necessary to intervene pre-operatively (except for **beta blocker therapy** or α_2 agonists) to improve perioperative outcome.

- a) **Beta blockers** have been shown to be **useful** in **reducing perioperative morbidity and mortality** in **high risk cardiac** patients and preferably titrated to a heart rate of **50 to 60 bpm**.
- b) The α_2 agonists by virtue of their **sympatholytic effects** can be **useful** in patients where beta blockers are contraindicated.
- c) **Nitroglycerine** lowers LVEDP by **reducing** preload. It **improves** collateral coronary flow and **reduce** systemic B.P.
- d) **Other agents like calcium channel blockers, ACE inhibitors, aspirin, insulin, and statins** Statins are drugs that can lower your cholesterol, **prove to be beneficial perioperatively**.

Coronary intervention should be **guided** by **patient's cardiac condition** (unstable **angina**, left main or equivalent **CAD**, three vessel disease, **decreased LV function**) and by the potential consequences of delaying the noncardiac surgery for recovery after coronary revascularization³.

Patients who underwent PCI had better outcome after noncardiac surgery. However the need for dual anti-plate-let therapy for several months to one year can significantly impact the perioperative course.

Acute postoperative stent thrombosis has been reported when “anti-platelet agents” were **temporarily held preoperatively to reduce chance of bleeding**. **Continuing** the therapy can lead to **significant postoperative bleeding**. **Discontinuing** or **modifying anti-platelet** therapy should involve a multidisciplinary team of *cardiologist, *surgeon, *anaesthesiologist⁸.

Preanaesthetic considerations

Preoperative visit to the patient is **very important**. A good rapport علاقة جيدة should be made with the patient and written consent obtained.

Patient should be **explained about the risk of *surgery and *anaesthesia**.

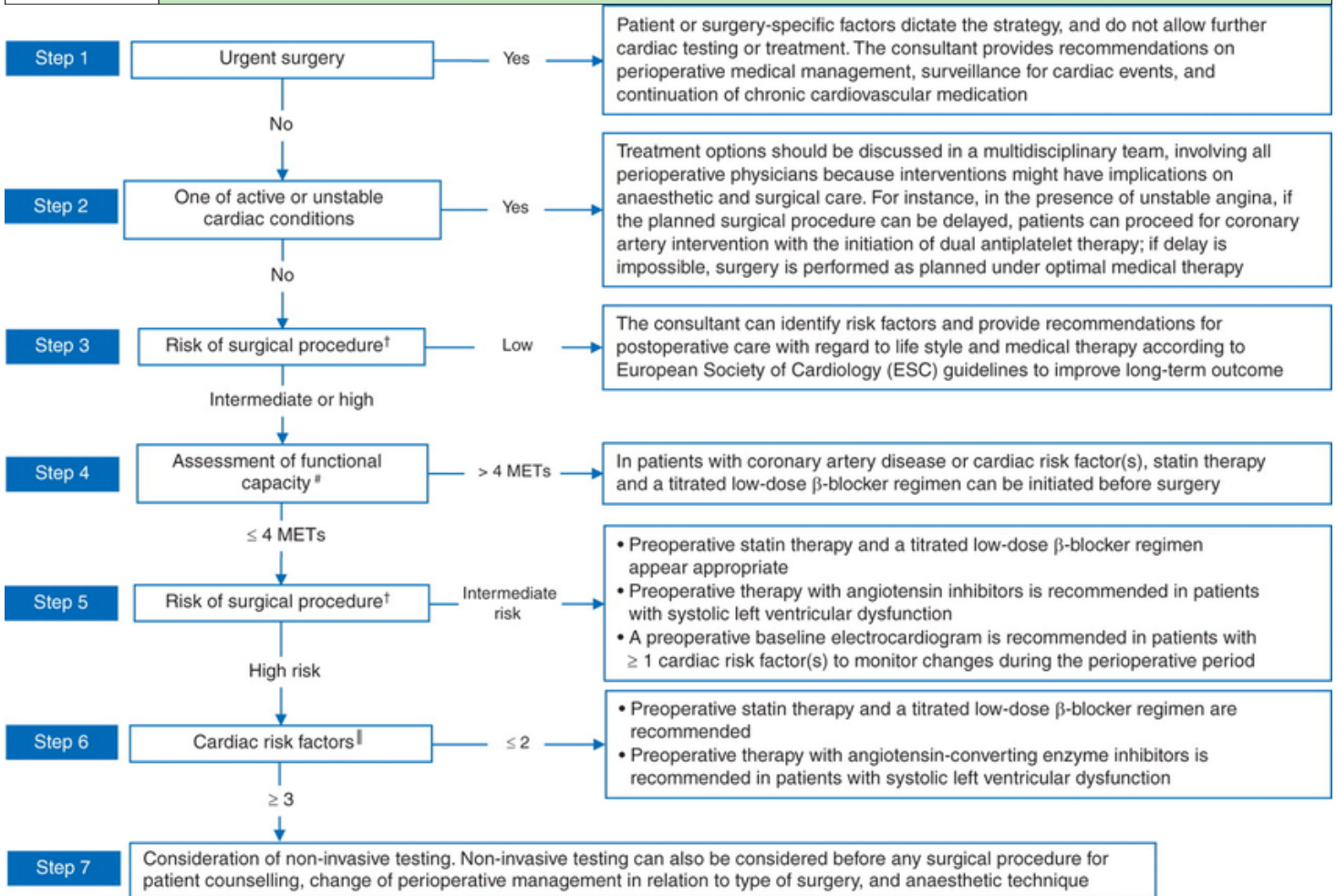
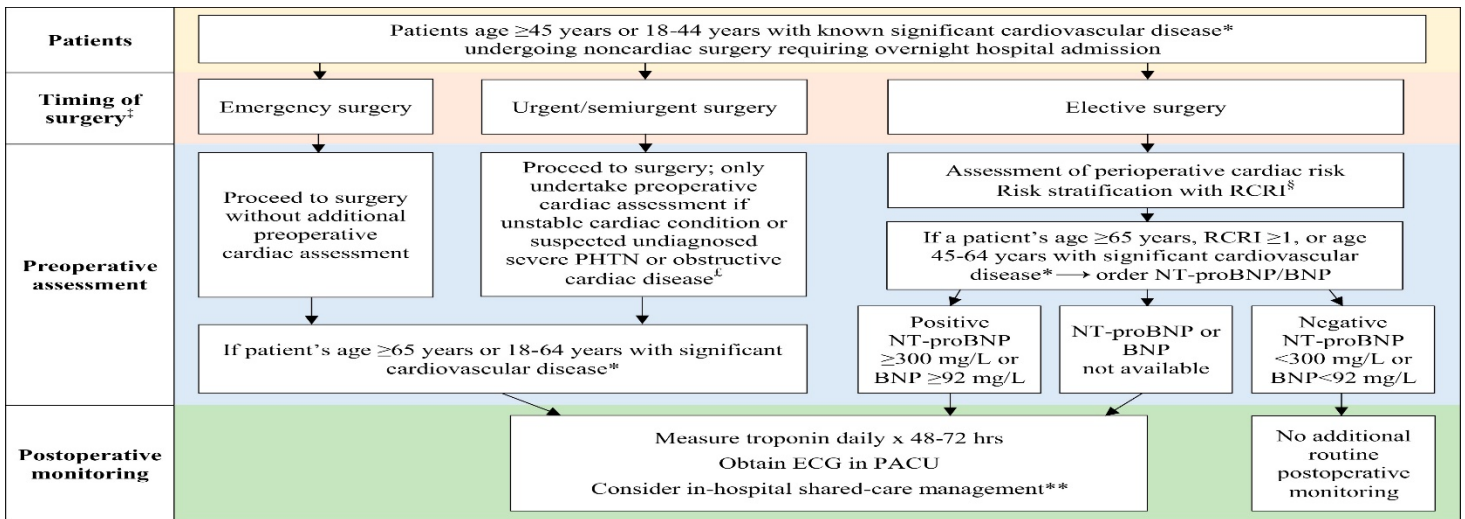
1. **It is important to continue the medications till the day of surgery like *beta blockers, *calcium channel blocker, and *digitalis**.
2. **Potassium** level **should be normal** as hypokalemia can cause **digitalis toxicity**.
3. **Anticoagulants** should be **stopped**(2-3 days).

Premedication

Significance of **premedication** in **allaying anxiety** تخفيف القلق in cardiac patients is of **paramount importance**. This is to **prevent *increase in B.P.** and ***HR** which can 1) **disturb the myocardial oxygen supply** and **demand** and 2) **can induce ischemia**.

Any combination of **benzodiazepine** like **lorazepam** and **opioid** like morphine **should be given one hour** prior to arrival in operation theatre.

The following **algorithm** helps in easy reference for **planning perioperative management** of cardiac patients undergoing noncardiac surgery.



Intraoperative management

Monitoring

Incidence of ischemia in the **intraoperative** period is **low** (as compared with pre and postoperative period)

- i. **ECG** is the most commonly used monitoring tool. If ECG is to be used effectively as an ischemic monitor, the monitor should be set on diagnostic mode. **Monitoring three ECG leads (II, V4, V5 or V3, V4, V5)** improves recognition of ischemia. **The ST segment** trending system also helps in the detection of ischemia
- ii. **Blood pressure**
- iii. **Pulse oximetry**
- iv. **Capnography** The term capnography refers to the noninvasive measurement of the partial pressure of carbon dioxide (CO₂) in exhaled breath expressed as the CO₂ concentration over time

- v. **Temperature monitoring**
- vi. **Urine output monitoring**
- vii. **Central venous pressure**
- viii. **Pulmonary artery pressure** and **cardiac output** - can be measured with pulmonary artery catheter as required. In a **haemodynamically unstable patient**, the requirement of volume or inotropes مؤثر في التقلص العضلي can be **judiciously بحكمة calculated** and **response monitored closely**
- ix. **TEE (transesophageal echocardiography)** is a sensitive monitor for ischemia. However TEE is not advocated for routine use.

Choice of anaesthetics

The anaesthesiologists should **select** the drugs with the objective of *minimizing demand and *optimum supply of oxygen.

Along with the anaesthetic agent some cardiac drugs should be readily available to *maintain haemodynamics, **to prevent & treat ischemia, if it occurs.

General anesthesia

1. Intravenous anaesthetics

Thiopentone —It **reduces** *myocardial contractility, *preload and *blood pressure and there is slight **increase** in heart rate. It **should be administered slowly** and **with caution**.

Propofol —It **reduces** *arterial blood pressure and *heart rate significantly. There is dose dependent **reduction** in myocardial contractility. It **can be used** in with **good ventricular function** but is not good induction agent for patients with CAD.

Ketamine —It is **not good** in *IHD and *valvular heart disease patients. It is however a **useful** agent in situations like cardiac tamponade and cyanotic heart disease.

Midazolam—It produces **decrease** in mean arterial pressure and **increase** in heart rate. It provides excellent amnesia and is **widely used** for patient with CAD.

Etomidate—It causes **minimum** haemodynamic **changes**. It is **excellent** for **induction** in patients with **poor** cardiac **reserve**.

2. **Narcotics**—**Morphine** is the **preferred** drug for its relative cardiac **stability** and very good **analgesic** effect. It produces arterial and venous dilatation, resulting in **reduction** of after load and preload. Newer narcotic analgesic agents like **fentanyl**, alfentanil and sufentanil also **provide adequate** cardiac stability and pain relief.
3. **Inhalational agents - Isoflurane** is **recommended** in patients with **good** myocardial contractility. **Halothane** has the **disadvantage** of myocardial depression and potential of **dysrhythmias**.
4. **Nitrous oxide**—It provides **stable** haemodynamics in cardiac patients.
5. **Muscle relaxants- Vecuronium** produces **minimum** haemodynamic **alterations** and is **short** acting, therefore **suitable** for use in cardiac patients. **Pipecuronium**, **mivacurium**, **doxacurium** are newer non depolarizing muscle **relaxants without** any significant cardiovascular **side effects**.
6. **Glycopyrrolate**—It is **preferred** over **atropine** since it **produces less tachycardia** & should be used only if specifically required.

Regional anesthesia

The potential and well known **advantage** of regional anesthesia over G.A should be an **asset in cardiac patients** if the surgery can be performed under regional block. Patient should be nicely **premedicated** مخدر without any apprehension تخوف.

Disadvantages of regional anesthesia **include hypotension** from uncontrolled **sympathetic blockade** and **need** for volume loading **can result in ischemia**.

Care should be taken while giving local anaesthetic **because** larger doses can cause **myocardial toxicity** and **myocardial depression**. Use of **epinephrine** with local anaesthetic is not recommended¹⁰.

Managing intraoperative complications

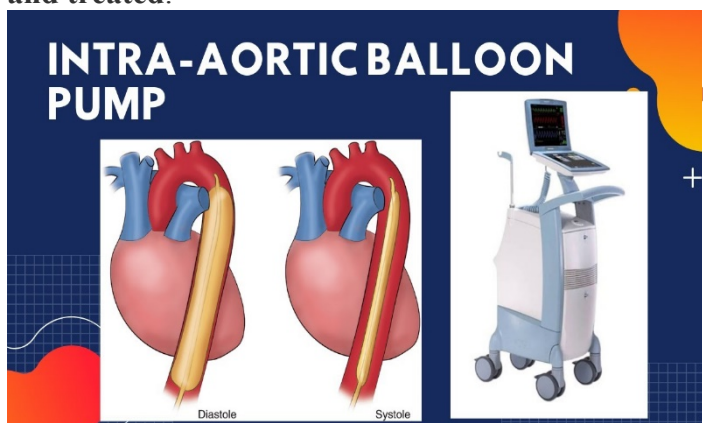
- 1) **Intraoperative ischaemia**
- *1 If patient is **haemodynamically stable**-
 1. 1- Beta blockers (I/V metoprolol upto 15mg)
 2. I/V Nitroglycerine
 3. Heparin after consultation with surgeon
- **2 If patient is **haemodynamically unstable**
 1. -Support with **inotropes** are medicines that change the force of your heart's contractions. There are 2 kinds of inotropes: positive inotropes and negative inotropes. Positive inotropes strengthen the force of the heartbeat. Negative inotropes weaken the force of the heartbeat.
 2. Use of **intraoperative balloon pump** may be necessary. An intra-aortic balloon pump (IABP) is **a type of therapeutic device**. It **helps your heart pump more blood**. You may need it if your heart is unable to pump enough blood for your body. The IABP consists of a thin, flexible tube called a catheter. Attached to the tip of the catheter is a long balloon.
 3. Urgent **consultation with cardiologist** to plan for earliest possible **cardiac catheterization**
- 2) Other complications like **dysrhythmias**, **pacemaker dysfunction** should be **managed** accordingly. A pacemaker is a small, battery-powered device that prevents the heart from beating too slowly. You need surgery to get a pacemaker. The device is placed under the skin near the collarbone. A pacemaker also is called a cardiac pacing device.

Post-operative management

Goals are same as intraoperative

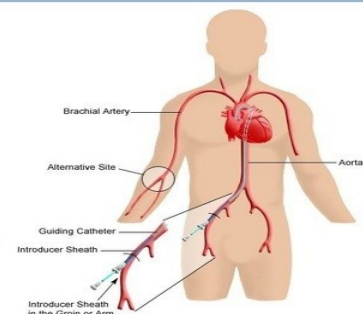
- Prevent ischaemia
- Monitor for MI
- Treatment for MI

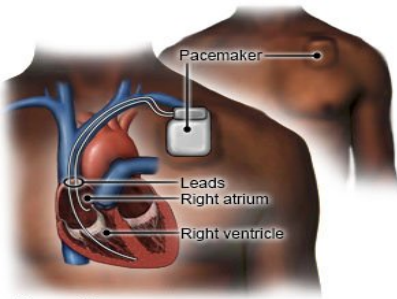
Although most cardiac events occur **within first 48 hours**, delayed cardiac events (within first 30 days) still happen and could be the result of secondary stress. Post-operative stress of **extubation**, **pain**, **sepsis**, **haemorrhage**, **anaemia**, **respiratory problems** **can increase the demand on the heart** and **should be minimized and treated**.



Cardiac Catheterization

- A diagnostic invasive procedure
- Catheter is inserted through a peripheral blood vessel into the heart, to visualize the structures inside & function
- Other purpose
 - To obtain cardiac tissue samples for biopsy.
 - Close small holes inside the heart
 - Place wire devices, called stents, in narrowed arteries to keep them open
 - Heart X-ray film





Pacemaker

