

CORONARY ARTERY DISEASE

EGYPTIAN HYPERTENSION SOCIETY GUIDELINES

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SUMMARY

INTRODUCTION

Coronary artery diseases (CAD) constitute a major health problem in many parts of the world and are an important cause of morbidity and mortality. It is predicted that by the year 2020, CAD will be the main cause of disability worldwide. In Egypt and other developing countries, there is a definite increase in the incidence of CAD. In a recent hospital based survey at Cairo University, Cardiology Department, we found a decline in University hospital admissions of rheumatic valvular heart diseases and an increase in number of hospitalizations secondary to CAD and its sequelae. It is expected that this trend will persist and become more manifest in the coming years.

The sharp decrease in infant mortality rate, control of many infectious and parasitic diseases and the progressively increasing average life expectancy of the population has changed the health profile in many third world countries. Urbanization, sedentary life style, high caloric - high fat diet combined with increased prevalence of hypertension, cigarette smoking, diabetes mellitus, obesity, dyslipidemia and social stress are important causes of the coming epidemic of CAD in Egypt and other developing countries. This trend should alert the health authorities, medical and scientific community and to take active measures in order to prevent, diagnose and adequately treat these life threatening disorders.

In the last three decades, various new techniques were introduced in the field of cardiology to help better management of coronary patients. From the diagnostic aspects, coronary arteriography, electrocardiographic stress testing, nuclear studies, echocardiography and other diagnostic techniques play an important role in detection, risk stratification and decision making in coronary patients, which guide the physician in planning the right therapeutic intervention.

Increased plasma low density lipoprotein cholesterol is now an established risk factor for CAD, the demonstration of the beneficial effect of cholesterol lowering in primary and secondary prevention of CAD underscores the important role of the recently introduced effective hypocholesterolemic therapy in the management of coronary patients. The introduction of coronary artery bypass graft surgery (CABG) and recently catheter intervention procedures to improve myocardial revascularization has definitely improved the outcome of many patients with severe CAD, specially those with poor left ventricular function. Management and prognosis of patients presenting with acute myocardial infarction (AMI) has changed dramatically after the introduction of coronary care units, thrombolytic therapy and new antiplatelet agents. Hospital mortality following AMI has dropped from 15 per cent to less than 5 per cent.

The previous achievements have their limitations, specially in third world countries. Many of the techniques and medications are very expensive and beyond the reach of both, the physician and the growing population of coronary patients and when available, they are many times misused, improperly utilized or wrongly indicated. Some of the procedures are risky and may carry serious complications. Many require adequate training and should only be performed by experienced persons. The available and the rapidly increasing list of new antiischemic drugs, antiplatelets, anticoagulants, fibrinolytics, antiarrhythmic and vasodilators will make the job of the practicing cardiologist difficult and incomplete unless he is familiar with the clinical pharmacology and proper dosages of the different medications.

Prevention of CAD is possible, but is frequently neglected. More than half of fatalities secondary to CAD occur outside the hospital and before the arrival of effective therapy. This stresses the important role of primary prevention in the management of the coming epidemic of CAD. The identification of new cardiovascular risk factors such as increased plasma fibrinogen, homocysteine, abnormalities in blood

platelets, coagulation factors and lipids will further broaden the scope of diagnostic evaluation and complicate the prevention program.

Realizing the possible confusion of the internist and cardiologist with this plethora of techniques, interventions and drugs, being aware of the limitations in medical school training and also of the important role of CAD as the main cause of morbidity and mortality in hypertensive patients. I invited, on behalf of the Egyptian Hypertension Society, a group of Egyptian experts in clinical cardiology representing different areas of expertise and with extensive background in the management of coronary patients to write a short manual about CAD, including the views and guidelines of the Egyptian Hypertension Society. The book is not meant to be a detailed reference textbook. Its main objectives is to provide medical students, interns, cardiology and internal medicine residents, general internists and cardiologists with a simple and practical manual that help management coronary patients based upon a modern scientific approach. It outlines the role, indications and limitations of different diagnostic and therapeutic interventions used in the care of coronary patients. A section on recommendations targets beside the medical community, the public, education and health planners.

The book is divided into four sections. The first section discusses the methods of diagnosis of CAD. Chest pain, the cardinal manifestation of CAD is addressed in the first chapter. The clinical features of coronary ischemic pain, its differential diagnosis, methods of evaluation and predicting the need for hospitalization are discussed. Exercise stress electrocardiography is possibly the most prescribed diagnostic procedure in coronary patients or those suspected of having CAD. The test is described in chapter 2. Although it has its limitations, it provides important diagnostic and prognostic information. Chapter 3 discusses the position of two imaging modalities in the diagnosis of CAD : *Nuclear and Echocardiographic Studies*. Chapter 4 is devoted to *coronary angiography* which is considered by many clinicians as the gold standard for CAD diagnosis. This procedure is sometimes overdone and with no clear indications.

Section B of the book addresses the treatment of different coronary syndromes, drug therapy and catheter intervention procedures. The management of stable angina, unstable angina and acute myocardial infarction are discussed in three separate chapters. Special emphasis is made on risk stratification in patients with these conditions. Identification of patients at increased risk of sudden cardiac death, non fatal myocardial infarction and heart failure is an important element in the evaluation of coronary patients. Patients

in the high risk category are candidates for coronary angiography and possibly for a revascularization procedure.

Section C discusses special topics in coronary patients. It includes risk stratification after AMI, CAD in women and prevention of CAD. Ethical and medicolegal aspects, an area which is often neglected by cardiologists is discussed in a separate chapter. The last chapter in this section is about cardiopulmonary resuscitation. Every cardiologist should be familiar with the basic and advanced cardiac life support techniques. The chapter contains important practical information that should be remembered by all practitioners.

The last section in the book outlines different sets of recommendations that address medical community, health care providers, medical education authorities and the public. Recommendations for physician and public education are discussed with detailed guidelines regarding the establishment and organization of coronary care units and emergency medical services.

Finally, I would like to thank all authors who contributed in the production of this manual. I am specially grateful to my assistant editors Dr. Sherif El-Tobgy and Dr. Hussein Rizk, and also, to my secretary Mrs. Amany Kandeel. The generous support and the educational grant provided by MSD-Egypt are very much appreciated, its contribution in preparation, printing and distribution of the book should be recognized.

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Cairo - September 1998.

Chapter 1 : Clinical Evaluation of Patients with Chest Pain

A-1.1 : Characteristics of Chest Pain of Ischemic (Coronary) Origin

A-1.2 : Pain that is Probably or Definitely Not Angina

A-1.3 : Other Causes of Chest Pain

A-1.4 : Electrocardiographic Changes

A-1.5 : Categorization of Patients with Chest Pain & Prediction of Need for Hospitalization

A-1.1 : Characteristics of Chest Pain of Ischemic (Coronary) Origin

A careful and detailed history is the corner stone in the clinical diagnosis of angina, physical examination and resting ECG are usually normal in patients with stable coronary artery disease (CAD) and in many patients with unstable angina.

The most important characteristics of anginal pain :

Paroxysmal nature that lasts few minutes with clear relationship between symptoms and physical exercise, emotions, heavy meals and cold weather

Rapid relief with rest or nitroglycerine.

Typically located in the retrosternal region, but it is also frequently experienced in the left hemithorax, in the left arm, in the epigastrium and in the neck. Less common locations are the right hemithorax, the right arm, inner side of the forearm and hand.

The character and severity of anginal pain vary from simple vague discomfort to severe agonising pain. It is described as heaviness, tightness, constricting, aching, squeezing, suffocating, stitching, tearing or burning. When felt in epigastrium, pain may simulate indigestion. Frequently belching and eructations may be present and relieve the discomfort.

Pain episodes last from five to ten minutes. Pain lasting for a few seconds or a fraction of a second or of hours duration is not angina.

The pain is usually of diffuse nature, the patient cannot localize its site by his finger but uses his palm or fist when asked about the site of pain.

Patients with unstable angina, non Q wave myocardial infarction or acute infarction present with resting chest pain of longer duration that lasts more than 20 minutes and may be few hours.

History that increase the likelihood of coronary artery disease include prior MI (history, ECG Q waves), male gender, old age, number of risk factors (diabetes, smoking, hypercholesterolemia, hypertension, family history).

Uncommon presentation of coronary patients are isolated, unexplained, new onset or worsened exertional dyspnea, nausea or faintness without chest discomfort.

A-1.2 : Pain that is Probably or Definitely not Angina

Sharp, knife-like pain brought on by respiratory movements or cough, e.g., pleuritic pain
Pain produced by movement or palpation of chest wall or arm.

Primary or sole location of discomfort in the middle or lower abdominal region.

Pain localized with one finger.

Constant pain lasting for days.

Very brief episodes of pain lasting a few seconds or less.

Pain radiating into the lower extremities.

A-1.3 : Other Causes of Chest Pain

Anxiety and chest pain of functional origin is possibly the most common condition to be differentiated from angina. Chest pain is a common complaint in patients with anxiety, depression, panic attacks and other psychologic disturbances. The pain is atypical commonly felt left inframmary. No definite relationship to exercise, but can be associated with emotions or occur spontaneously. Chest discomfort is usually associated with other symptoms of anxiety such as difficulty in getting the air inside the chest, frequent sighing, palpitations and multiple other unrelated complaints. The patient is not sure of his symptoms and cannot clearly describe his chest discomfort. History of emotional conflict or psychic stress may be present.

ECG abnormalities present in patients with anxiety and functional chest pain might confuse the physician. These are in the form ST- and T-wave changes secondary to hyperventilation - a common manifestation of anxiety-or to excessive sympathetic adrenergic activity.

Pain due to oesophageal, gall bladder and

gastrointestinal disturbance : Pain due to oesophageal spasm is retrosternal and may be relieved by

nitroglycerin, but lacks the other characteristics of

anginal pain. **Splenic flexure syndrome** with gaseous

distension of the colon can produce chest discomfort

relieved by passage of flatus. **Gall bladder disease** may

present with chest or shoulder pain. **Musculo-skeletal**

pain is felt over muscles, joints or tendons associated

with local tenderness, limitations or painful movement of the involved part.

Mitral valve prolapse may produce stabbing or burning

chest pain that is quite variable in position and from one

episode to another, and varies greatly in intensity and

tends to be unrelated to physical exertion and

unresponsive to nitroglycerin. Its duration may be

evanescent (seconds) or persists over many hours or days. ECG abnormalities, may be present in mitral valve prolapse.

In pericarditis pain is sharp, localized, stabbing or cutting, made worse by coughing, swallowing, deep breathing and lying down. It is diminished by leaning forward and remaining still. It is commonly associated with pericardial rub and electrocardiographic changes. It lasts for hours or days.

A-1.4 : Electrocardiographic Changes

The resting 12-lead standard ECG is normal in the majority of patients with stable CAD and in many patients with unstable angina. Transient ST- T-wave changes that develop during symptomatic episode at rest and resolves when the patient is symptom-free strongly suggest a very high likelihood of underlying severe CAD. ST-segment and T-wave changes are the primary elements upon which an ECG diagnosis of acute ischemia is based.

ST-segment elevation ≥ 1 mm in two or more contiguous leads strongly suggests the diagnosis of acute myocardial infarction (AMI). ST-segment depression or inverted T-wave specially when T waves are inverted ≥ 1 mm in leads with dominant R wave signifies ischemia or non-Q wave infarction.

Other causes of ECG abnormalities should be excluded when evaluating patients presenting with chest pain and an abnormal ECG. ST-segment elevation ≥ 1 mm in two or more contiguous leads can be present not only in AMI, but also in patients with acute pericarditis, early repolarization, left ventricular aneurysm and coronary artery spasm. ST-segment depression ≥ 1 mm is present in normal heart, hyperventilation, left ventricular hypertrophy and strain, digitalis, hypokalemia and hypomagnesemia. Inverted T waves in two or more contiguous leads (≥ 1 mm in leads with dominant R wave) can be present in normal heart, hypertrophic cardiomyopathy or disorders of central nervous system.

A-1.5 : Categorization of Patients with Chest Pain and Prediction of Need for Hospitalization

Admission to CCU is appropriate for patients with a probability of acute MI or unstable angina at moderate or high risk. (see chapters on Risk Stratification : B-6.2). In patients in whom diagnosis is uncertain and those considered to be at low risk, an observation period of 12 hours or less seems sufficient. These low risk patients should undergo follow-up evaluation within 72 hours.

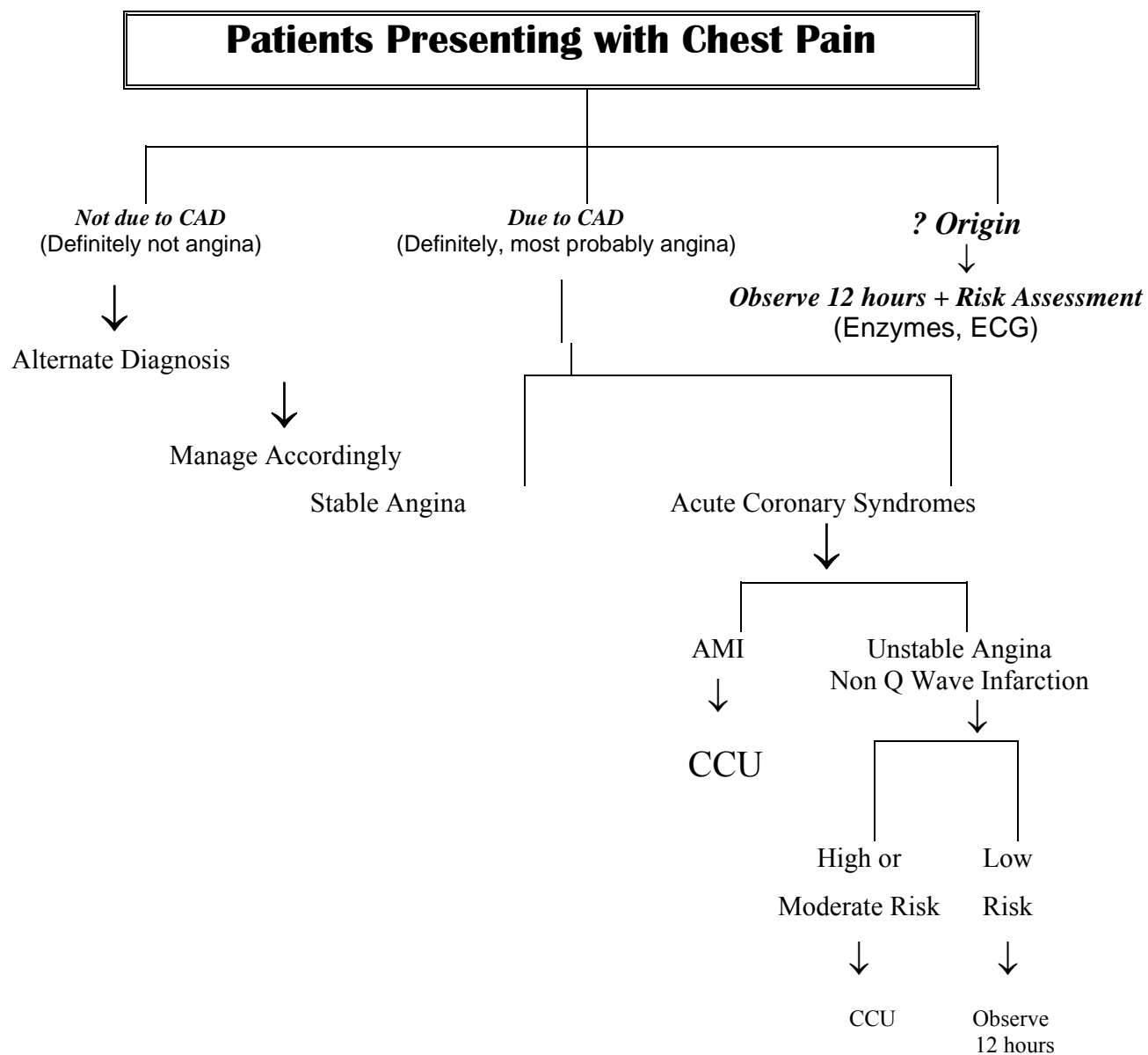


TABLE : Causes of Chest Pain

CARDIAC CAUSES	NON-CARDIAC CAUSES
1. CAD Stable Angina Unstable Angina, Non-Q Wave infarction Q-Wave Infarction Coronary Artery Spasm - Prinzmetal Angina 2. Pericarditis 3. Pulmonary Embolism 4. Aortic Dissection 5. Mitral Valve Prolapse 6. Hypertrophic Cardiomyopathy 7. Severe Pulmonary Hypertension 8. Aortic Valve Disease	1. Anxiety, hyperventilation, panic attacks, depression, 2. Pleurisy, pneumothorax Musculo-skeletal Pain : Myositis, tendinitis, costochondritis, spondylosis 4. Esophageal Disorders : Esophageal Spasm, esophagitis, hiatus hernia, oesophageal rupture. 5. Gall Bladder Disorders : Gall stones 6. Obstructive air way disease ? 7. Pre-eruptive phase of Herpes Zoster 8. Splenic flexure syndrome, colitis 9. Gastritis, peptic ulcer 10. Mediastinitis

Chapter 2 : Exercise ECG Stress Testing

A-2.1 : Indications & Pathophysiologic Basis of Stress Testing

A-2.2 : Indications to Stop Exercise Tolerance Test (ETT)

A-2.3 : Contraindications to Exercise Testing

A-2.4 : Conditions Requiring Special Consideration, Precautions, Exercise ECG has Limited Diagnostic Value.

A-2.5 : Technique of Multistage Submaximal or Maximal Exercise Test

A-2.1 : Indications and Pathophysiologic Basis of Stress Testing :

A number of exercise tests are employed in the evaluation of coronary heart disease. The exercise tolerance test (ETT) is the most commonly performed. The ETT is used most commonly to diagnose the presence of CAD. It may also be used, however, to provide serial monitoring in cases of established CAD, judge progress in post-MI rehabilitation, provide baseline data before recommendation of an exercise program, document cardiovascular disability, evaluate results of revascularization procedures or for risk stratification. The main aspects of cardiovascular function judged by ETT are :

- Adequacy of cardiac output.
- Presence of exercise-provoked myocardial ischemia.
- Cardiac conduction.
- Presence of exercise-provoked arrhythmias, and
- Heart rate response.

The current protocol employed in most hospitals involves walking or running or both on a treadmill at gradually progressive speed and gradually increased incline. The safety record for centers that perform ETTs should be excellent. This is only possible by careful screening of patients before testing and careful monitoring during and after the procedure.

A-2.2 : Indications to Stop Exercise Tolerance Test (ETT) :

- Three consecutive PVCs.
- Progressive anginal pain.
- Staggering or ataxic gait.
- Decrease in blood pressure below resting level.

- Exhaustion : Patient is unable to continue or requests to stop test.
- Patient looks pale and clammy, vasoconstricted.
- S-T depression > 3mm or more. ST elevation, 2 mm or more in leads with no Q wave.
- Development of bundle branch block, heart block (second or third degree), atrial tachycardia, flutter or fibrillation.
- Failure of blood pressure to rise, or extreme elevations in blood pressure.
- Frequent or complicated PVCs : in pairs or with increasing frequency as exercise increases.
- Equipment malfunction.

A-2.3 : Contraindications to Exercise Testing :

I. Absolute Contraindications :

1. Congestive heart failure.
2. Acute MI with evidence of instability.
3. Active myocarditis.
4. Highly unstable angina pectoris with chest pain in the past 48 hours..
5. Recent embolism, either systemic or pulmonary.
6. Dissecting aneurysm.
7. Acute infectious diseases.
8. Thrombophlebitis.
9. Aortic stenosis (moderate to severe).

II. Relative Contraindications :

- i. Uncontrolled or high-rate supraventricular dysrhythmias.
- ii. Repetitive or frequent ventricular ectopic activity.
- iii. Untreated severe systemic or pulmonary hypertension.
- iv. Ventricular aneurysm.
- v. Mild to moderate aortic stenosis.
- vi. Uncontrolled metabolic diseases (diabetes, thyrotoxicosis, myxedema).
- vii. Severe hypertrophic obstructive cardiomyopathy (subaortic stenosis).
- viii. Marked cardiac enlargement.
- ix. Toxemia of pregnancy.

A-2.4 : Conditions Requiring Special Consideration, Precautions, Exercise ECG has Limited Diagnostic Value :

- a. Conduction disturbances.

1. Complete AV look.
2. Left bundle branch block.
3. Wolff-Parkinson-White Syndrome.

- b. Pacemakers.
- c. Dysrhythmias.
- d. Electrolyte disturbances.
- e. Certain cardiac medications.
 1. Digitalis.
 2. Beta-blocking drugs and drugs of related action.
- f. Severe hypertension (diastolic pressure over 110 mm Hg).
- g. Cyanotic heart disease.
- h. Intermittent or fixed right-to-left shunts.
- i. Severe anemia.
- j. Marked obesity.
- k. Renal, hepatic and other metabolic insufficiency.
- l. Overt psychoneurotic disturbances requiring therapy.
- m. Neuromuscular, musculoskeletal and arthritic disorders that prevent activity.

A-2.5 : Technique of Multistage Submaximal or Maximal Exercise Test :

1. Patients exercise on a treadmill or bicycle ergometer.
2. Patients exercise until a predetermined heart rate is reached or exhaustion or clinical condition warrants terminating the test prematurely.
3. The submaximal test is usually performed until the patient achieves a heart rate of 110 or 120 beats/minute. The maximal exercise test continues until the patient heart rate reaches 85% or 90% or predicted maximum heart rate for age and sex, which 220-patient age in years.
4. The speed and grade of the treadmill or the resistance of the bicycle ergometer is increased every three minutes until the target heart rate is achieved or exhaustion or clinical condition warrants termination of the test.
5. A baseline resting ECG is recorded before the test. Electrocardiographic and blood pressure monitoring are carried out at every stage during the exercise period. ECGs and BPs are recorded at 0, 1, 2, 5 and 10 minutes after exercise.
6. A diagnosis of functional myocardial ischemia is based on 1.0 mm of horizontal or downsloping of S-T segment depression.

Chapter 3 : Nuclear Studies &

Echocardiography

A-3.1 : Instrumentation

A-3.2 : Indications

A-3.3 : Image Interpretation

A-3.4 : Diagnostic Value & Limitations : Comparison with Stress Echocardiography

A-3.5 : Echocardiography

A-3.6 : Indications for Echocardiography

A-3.7 : Trans-Esophageal Echo (TEE)

A-3.8 : Stress Echocardiography

MYOCARDIAL PERFUSION IMAGING

Radionuclide-nuclear-studies are well established techniques which offer valuable information regarding myocardial perfusion, function and viability.

A-3.1 : Instrumentation

The equipment used in nuclear studies is called the Gamma Camera, composed of a head which can be single or multiple. It acquires radioactivity emanating from the target organ. A computer system, which analyzes, stores and displays acquired images.

Radiopharmaceuticals :

Radioactive tracers injected intravenously and help to visualize target organs. Most commonly used tracers in cardiology : Thallium 201 & Technitium 99m.

- Radionuclide Imaging Modalities :
- Radionuclide Angiography : used for the assessment of LV function and wall motion abnormalities.
- Myocardial perfusion imaging (SPECT) : used for the assessment of myocardial blood flow distribution at peak stress and rest.

A-3.2 : Indications

- Patients in whom ECG stress test will not be informative, e.g., left ventricular hypertrophy, LBBB, WPW, pacemaker, on digitalis.
- Patients in whom ECG stress test was non diagnostic, e.g., not completed, did not reach the target heart rate, questionable ST-segment changes.
- Patients unable to exercise (e.g., arthritis).
- Assessment of myocardial viability, i.e., ability of myocardial muscle to restore its normal contractile function after reinstatement of adequate coronary blood flow.
- Assessment of restenosis after PTCA or CABG.
- Risk stratification and prognosis, i.e., patients at high risk of developing myocardial infarction, heart failure or sudden cardiac death.

A-3.3 : Image Interpretation

There is a direct relationship between radiotracer uptake by myocardial cells and blood flow distribution, i.e., well perfused areas will show maximum radiotracer uptake and maximum activity. Scar tissue will show no activity. Ischemic area will show reversible activity : hypoactivity during exercise and normal activity at rest.

A-3.4 A-3.4: Diagnostic Value & Limitations : Comparison with Stress Echocardiography

	Stress Echocardiography	Stress Perfusion Scintigraphy
Equipment	Low cost Portable	Relatively expensive. Laboratory-based.
Personnel	“Learning curve” for acquisition and reading	Relatively automated.
Imaging	No radiation Rapid, instant results On-line, real-time imaging Tomographic	Radiation exposure. Time consuming. Off-line, “snapshot” at peak stress. Perfusion.
Reporting	Regional function / thickening Usually qualitative Global function (EF, ESV)	Regional flow heterogeneity. Quantitation well accepted. Global function (lung-heart ration, gated SPECT).
Benefits	Identifies other sources of chest pain Ischemic threshold assessed Safety Therapy assessment	Widespread experience. Less vulnerable to submaximal stress.
Problems	Variable echo window Endocardial border definition	Artifacts due to breast tissue, left bundle branch block or left ventricular hypertrophy.

Abbreviations : SPECT : Single-Photon emission Computed Tomography. EF : Ejection Fraction. ESV : End-Systolic Volume.
ECHOCARDIOGRAPHY

A-3.5 : Role in Coronary Artery Disease

- Provides accurate information on both systolic and diastolic left ventricular function.
- Assess regional wall motion abnormalities and myocardial scarring which are the signs of coronary artery disease.
- Detect any associated complication such as mitral regurgitation, intracardiac thrombus, cardiac aneurysms and pericardial effusion.

A-3.6 : Indications for Echocardiography

Patients with Chest Pain :

1. Evaluation of chest pain in patients with suspected acute myocardial ischemia, when baseline ECG is nondiagnostic. The absence of regional wall motion abnormalities excludes high risk patients with an acute myocardial infarction.
2. Diagnosis of other cardiac causes of chest pain : valvular (e.g., mitral valve prolapse, aortic

valve disease), pericardial, primary myocardial disease or aortic dissection.

Patients with Definite CAD :

Recommended in all patients with acute MI in order to :

1. Assess infarct size.
2. Assess ventricular function.
3. Detect complications.

Findings will help in directing therapy and assessing the prognosis.

A-3.7 : Trans-Esophageal Echo (TEE) :

Transesophageal echo may be needed in some patients, particularly those with serious hemodynamic compromise but nondiagnostic transthoracic studies.

A-3.8 : Stress Echocardiography

This is a newly introduced technique. At present it is only available in some specialized cardiac centers in Egypt.

Technique :

A variety of methods can be used to induce stress, either exercise (treadmill, upright or supine bicycle) or pharmacologic using adrenergic stimulation, e.g., Dobutamine (common) or vasodilator agents, e.g., Dipyridamole (less common). The technique depends upon demonstration of development of regional wall motion abnormalities by two-dimensional echo during or following stress.

Indications :

Routine ECG exercise stress testing non diagnostic.
Presence of factors making ECG uninterpretable (digoxin, LBBB, WPW, Pacemaker)
Women (standard treadmill exercise has low specificity ~ 50%).
Study of myocardial viability in post infarction patients (Pharmacologic testing).
Patients unable to exercise (Pharmacologic testing).

Interpretation :

Accuracy of Different Diagnostic Approaches for CAD :

Normal response to stress testing is increase in myocardial contractility with increase in systolic thickening of LV wall. Signs of myocardial ischemia during or following stress test includes development of regional wall motion abnormality [hypokinesis : diminished inward movement (excursion) of the endocardium, akinesis : absent excursion, dyskinesis : outward paradoxical excursion during systole]. Failure of systolic thickening of one or more segments of left ventricular wall or septum. Other signs of ischemia include deterioration in LV function and drop of systolic blood pressure with exercise.

Comparison with Stress ECG & Nuclear Studies :

Standard treadmill exercise testing is widely available and is less expensive than the imaging techniques. In many patients, standard exercise electrocardiography is almost as accurate as the exercise imaging modalities for identifying those with left main or three-vessel coronary artery disease. Advantages of stress echocardiography in comparison with standard exercise electrocardiography include greater accuracy when the resting electrocardiogram shows abnormal findings, higher sensitivity, ability to localize and characterize the extent of myocardial ischemia, and allow measurement of other variables such as left ventricular function. Stress echocardiography must be performed in experienced laboratories in order to provide accurate information. In comparison with the nuclear cardiology techniques, stress echocardiography is less expensive and provides more information on regional and global left ventricular function.

Referral of CAD patients to either stress echocardiography or thallium studies should be left to the choice of the cardiologist in charge and it is usually based on availability and experience in either technique in the center in which the cardiologist is practicing. Both techniques have comparable sensitivity and specificity, 85 - 95% and 85 - 90%, respectively for diagnosis of myocardial ischemia.

The sensitivity of different tests increases with more involvement and greater number of diseases coronary artereries.

	ECG	Echo	SPECT	Angio
Sensitivity (%)	68	75	84	99
Specificity (%)	77	90	87	99

Abbreviations: Angio = Angiography, CAD = Coronary Artery Disease, Echo = Echocardiography

ECG = Exercise electroCardioGraphy, SPECT = Single Photon Computed Tomography : Nuclear Studies.

Chapter 4 : Coronary Angiography

A-4.1 : Technique & Equipment

A-4.2 : Indications for Coronary Angiography

- a) Asymptomatic Patients
- b) Stable Angina Pectoris
- c) Unstable Angina
- d) Atypical Chest Pain
- e) Acute Myocardial Infarction
 - a. In Hospital
 - b. After Hospital Discharge
- f) Valvular & Congenital Heart Disease

A-4.3 : Nonindications for Coronary

Angiography

A-4.4 : Limitations of Coronary Angiography

A-4.5 : Value in Decision Making

Coronary angiography is considered the best available technique for delineation of coronary artery anatomy, and luminal abnormalities.

Analysis of the angiographic data helps in the choice of the mode of treatment, either by medical, surgical or catheter based interventional method.

A-4.1 : Technique & Equipment

The procedure of cardiac catheterization needs :

- a) Catheterization laboratory facilities
- b) Personnel : Well trained doctors, nurses and technicians.
- c) Protocol for cardiac catheterization : This includes :
 1. Precatheter preparation of the patient. The patient should be informed about risk and benefit of the procedure. Patient consent is necessary.
 2. Procedure :

- a. Transfemoral (Judkins)
- b. Anticubital (Sones)
- c. Transradial

A-4.2 : INDICATIONS FOR CORONARY ANGIOGRAPHY

The following specific indications for coronary angiography are based on ACC/AHA guidelines for coronary angiography, and for the management of patients with acute myocardial infarction.

a. ASYMPTOMATIC PATIENTS :

- High risk stress test either electrocardiographic or using nuclear imaging studies
- Positive stress test + occupational hazard
- Positive stress test + prior myocardial infarction
- Positive stress test + prior CABG or PTCA.

b. STABLE ANGINA PECTORIS :

1. Inadequate response to medical treatment : Frequent, severe anginal pains inspite of intensive medical therapy or following PTCA or CABG surgery.
2. Intolerance to medical treatment.
3. High risk stress test.
4. Angina following PTCA or CABG.
5. Survivors of cardiac arrest without MI
6. Before major vascular surgery.
7. Positive stress test + major nonvascular surgery.

8. Positive stress test + 2 or more risk factors (diabetes, hypercholesterolemia, cigarette smoking, hypertension, old age, family history).
9. Positive stress test + impaired LV function.
10. Young male patient + risk factors + recent symptoms of myocardial ischemia.

c. UNSTABLE ANGINA :

1. Patients with high risk features (For risk stratification see chapters on Stable Angina and Risk Stratification After Myocardial Infarction).
2. Continued symptoms despite medical treatment.
3. Intermediate or low-risk patients with positive stress test.
4. Left ventricular dysfunction or heart failure.
5. Prior myocardial infarction + 2 risk factors.
6. Prior PTCA or CABG surgery.
7. Malignant ventricular arrhythmias.

d. ATYPICAL CHEST PAIN :

- High risk stress test
- 2 risk factors + impaired LV function
- 2 risk factors + equivocal stress test
- 2 risk factors + uncontrollable symptoms and excessive anxiety

e. ACUTE MYOCARDIAL INFARCTION :

1. In Hospital :

- Infarct extension or recurrent infarction.
- Recurrent episodes of ischemia.
- Cardiogenic shock, persistent pulmonary congestion or haemodynamic instability.
- Failed thrombolysis for evolving anterior MI or large MI.
- Suspected mechanical complication (ruptured septum, pseudoaneurysm).
- When primary PTCA for acute and evolving MI is advised.

2. After Hospital Discharge :

- Recurrent spontaneous or stress-induced myocardial ischaemia.
- Malignant ventricular arrhythmias.
- Patients with CHF or reduced EF $\leq 40\%$ with evidence of viable myocardium or inducible ischemia.

- Non-Q MI in high risk patients.

f. VALVULAR & CONGENITAL HEART DISEASE :

- Before surgery in males > 40 or post-menopausal females.
- Angina or other evidence suggestive of coronary artery disease.
- To define congenital coronary anomalies.

Definition of High Risk Tests :

1. High Risk Exercise ECG Test :

- Duration : < stage II Bruce protocol or < 6 METS.
- ST depression : < 6 METS, ≥ 2 mm, involving ≥ 5 leads, lasting ≥ 6 min. postexercise.
- Sustained decline > 10 mmHg or flat systolic blood pressure response.
- Angina pectoris.
- Exercise-induced sustained VT.
- High risk myocardial perfusion test :
- Multiple reversible defects ≥ 2 regions.
- Large perfusion defects.
- Increased lung uptake.
- Exercise-induced LV dilatation.

3. High risk radionuclide ventriculogram :

- A fall in EF ≥ 0.1 during exercise
- Exercise EF < 0.5

A-4.3 : Nonindications for Coronary Angiography

Overutilization of coronary angiography in the absence of a clear impact on the patient's diagnosis, management or prognosis should be discouraged.

Coronary angiography is deemed unnecessary and should be avoided in the following clinical situations :

- As a first screening test in asymptomatic patients who have not had a noninvasive test.
- Patients with mild stable angina well controlled on medical treatment.
- Repeat angiography in patients with atypical symptoms and negative stress test who previously had a normal angiogram.
- Asymptomatic stable patients after acute myocardial infarction in the absence of the criteria mentioned above.

- It is not routinely indicated for evaluation of patients with valvular or congenital heart disease.

A-4.4 : Limitations of Coronary Angiography

- It is an invasive procedure which entails a certain risk of death 0.14%, acute myocardial infarction 0.1-0.4 %, stroke 0.1-0.2%, and vascular complications 0.4%.
- It requires the use of contrast agents carrying the hazards of anaphylactic shock, allergic reactions and nephrotoxicity (total 1-2%).
- The cost of angiography is high because of the use of sophisticated technology, equipment and disposables and the need for a skilled team of physicians and personnel.
- Cardiac catheterization laboratories are available only in highly specialized cardiac centers.
- There is difficulty in estimating the extent of atherosclerotic lesion, since it visualizes only the lumen of coronary arteries.

A-4.5 : Value in Decision Making

- It is the best available method for delineation of coronary artery anatomy, pathology and luminal abnormalities. It is essential for the diagnosis of coronary artery spasm, total occlusion, ectasia, diffuse atherosclerosis, and congenital anomalies. It determines the presence or absence of coronary atherosclerosis and provides important data regarding its severity, extent and morphologic characteristics
- It provides essential information before cardiac surgery and catheter interventions, and it is the most useful method for subsequent follow up of patients subjected to these procedures.
- Certain angiographic findings have a significant bearing on the determination of prognosis and patient management. Examples include left main disease, multivessel disease, the size and myocardial distribution of stenosed vessels, the presence of collateral supply, the status of distal runoff.
- In high risk categories of patients with unstable angina, non-Q / or Q - myocardial infarction, early coronary angiography allows the selection of those who would benefit from urgent revascularization.
- No direct evidence to support the routine use of coronary arteriography after infarction. The

addition of the results from coronary arteriography to the clinical and exercise data did not significantly improve the ability to predict subsequent mortality.

- Angiographically, significant coronary arterial lesions of > 50% diameter stenosis are not necessarily associated with subsequent myocardial infarctions. Large proportions of recurrent myocardial infarction are related to minimal lesions (< 50% diameter stenosis) with rupture of the atherosclerotic plaque in the minimal lesion.

Chapter 5 : Stable Angina

B-5.1 : Definition and Pathophysiologic Mechanisms

B-5.2 : Risk Stratification

B-5.3 : Modes of Therapy

B-5.4 : General Measures

B-5.5 : Medical Treatment

B-5.6 : Revascularization Procedures

B-5.1 : Definition and Pathophysiologic Mechanisms

Angina pectoris is a clinical syndrome of transient reversible myocardial ischemia induced by a discrepancy between myocardial oxygen demand and supply. Angina is considered to be stable when the frequency, duration and modes of precipitation and relief of symptoms remain unchanged over a duration of 2 months or more. Reduced myocardial oxygen supply occurs usually as a result of fixed coronary atherosclerotic narrowing (> 70%) and less frequently due to coronary vasospasm. Increased demand is caused by increased heart rate, systolic blood pressure and myocardial contractility during physical and mental stress.

B-5.2 : Risk Stratification

Based upon a number of clinical and investigatory data, patients can be classified into low - moderate and high risk categories (see chapters on Coronary Angiography and Unstable Angina). The annual mortality rate in the low risk category is less than 1% while it is more than 5% in those identified as high risk.

I. Low Risk Category : will include patients having the following characteristics :

1. Age 65 years or less

2. Mild to moderate symptoms - "Class I & II classification of the Canadian Cardiovascular Society".
3. Normal LV dimensions and function.
4. On exercise testing, they are able to go into stage 3 or beyond of a Bruce protocol without symptoms or ECG abnormalities.

II. High Risk Category : will include patients having the following characteristics :

1. Significant angina interfering with the patient's life style. "Class III & IV" Canadian classification in spite of aggressive medical treatment.
2. Uncontrolled risk factors or LV dysfunction.
3. On exercise testing, they are unable to complete stage 2 of a Bruce protocol without symptoms or ECG changes, diagnostic S-T changes in stage I, failure to increase systolic BP with exercise or develop exercise induced hypotension.
4. Large reversible defects on isotopic nuclear perfusion imaging with increase in lung uptake.

III. Intermediate Risk Category : will include patients having the following characteristics :

1. Age above 65
2. Those who can exercise beyond stage 2 of a Bruce protocol but with less than satisfactory control of symptoms on optimal therapy.
3. Large reversible defects on perfusion imaging without increase in lung uptake.

The majority of patients, (low risk and some of intermediate risk categories) can be managed by medical therapy, the rest will eventually need a revascularization procedure after being evaluated by coronary angiography.

B-5.3 : Modes of Therapy

Treatment of stable angina includes :

- general measures,
- medical treatment,
- interventional therapy and surgical revascularization.

B-5.4 : General Measures

This is an essential element of treatment to be applied to all patients, which includes :

- Control of hypertension, diabetes, dyslipidemia and other modifiable risk factors.
- Abstinence from smoking and weight reduction of obese patients.
- Treatment of aggravating conditions, e.g., anemia, thyrotoxicosis and anxiety.
- Gradual institution of an exercise program to improve physical fitness and reduce oxygen requirements for a given exercise work load.
- Avoidance of activities that exacerbate angina like exposure to cold weather and exercise after meals.
- Reassurance, explanation, resolving family and job conflicts.
- Aggressive dietary measures and if necessary drug regimen to reduce blood cholesterol (LDL-C to less than 100 mg/dl).

B-5.5 : Medical Treatment

The goals of treatment are to alleviate symptoms, reduce mortality and acute coronary events. Nitrates, beta blockers and calcium antagonists are used singly or in combination to reduce myocardial oxygen requirements and increase its blood supply. Monotherapy by sublingual nitrates may be sufficient in mild cases, to relieve symptoms but most patients will require combined therapy. Beta blockers are the only drugs of proven benefit for reducing the incidence of acute events and overall mortality.

Long acting nitrates and calcium antagonists are given to alleviate symptoms.

Unless contra-indicated aspirin and beta blockers

should be given to all patients to improve survival and reduce acute events. Other adjuvant therapy like ACE inhibitors in the absence of hypertension, antioxidants and agents that alter energy metabolism of the heart (trimetazidin) are awaiting future confirmation of proved benefit in large clinical trials. Nitrates should be given in the maximal tolerable dosages, and beta blockers in doses sufficient to achieve effective beta blockers before describing failure of medical treatment. Also, blood pressure should be carefully monitored in order to avoid excessive hypotension which can interfere with coronary perfusion and precipitate angina.

B-5.6 : Revascularization Procedures

Coronary artery bypass surgery is the treatment of choice in patients with left main disease and multivessel disease specially with impaired left ventricular function and those anatomically unsuitable for angioplasty. High risk patients and those not responding satisfactorily to optimal medical treatment are candidates for coronary angiography in preparation for revascularization. Patients with stable angina referred for revascularization should have objective evidence of myocardial ischemia by stress testing and / or severe coronary artery atherosclerosis compromising large areas of ischemic myocardium. PTCA is indicated in patients with 1 and 2 vessel disease who have normal or mildly impaired left ventricular function and suitable coronary artery anatomy.

Chapter 6 : *Unstable Angina and Non-Q Wave Myocardial Infarction*

B-6.1 : Definition and Pathophysiologic Mechanisms
 B-6.2 : Risk Stratification, Hospitalization & Monitoring
 B-6.3 : General Measures
 B-6.4 : Medical Treatment
 B-6.5 : Revascularization Procedures

B-6.1 : Definition and Pathophysiologic Mechanisms

- Unstable angina is one of the presentations of acute coronary syndromes. It is characterized by prolonged ischemic chest pain in the absence of serial ECG or enzymatic changes consistent with myocardial infarction. It includes the following subsets :
 - Angina at rest of recent onset within one week.
 - Recent aggravation of pre-existing angina to functional class III presenting as increased duration, severity, frequency and ease of symptom provocation.
 - Early post-infarction angina (> 24 hours - 2 weeks).
 - Recent onset angina on effort functional class III, onset less than 2 months duration.

Unstable angina usually occurs as a result of fissuring or rupture of a thinly covered lipid-rich atherosclerotic plaque which may not be initially obstructive. Platelet aggregation and fibrin deposition result in thrombus formation which may be partially or intermittently occlusive. Thrombosis in conjunction with coronary

artery spasm results in a critical reduction of myocardial blood supply. Death occurs in 4% of patients and nonfatal myocardial infarction in 7% within 3 months of the onset of symptoms.

- Secondary unstable angina is precipitated by aggregating medical conditions (fever, severe anemia, arrhythmias, thrototoxicosis..), adverse environmental circumstances and causes of obvious excessive sympatho-adrenal stimulation. It has a better prognosis. Treatment should be directed primarily at correction of the aggravating factors.

- Non-Q Myocardial Infarction : This is the second major presentation of acute coronary syndromes. It is recognized as prolonged chest pain associated with ST deviation or T wave inversion and serial elevation of cardiac enzymes in the absence of Q-waves. The underlying pathogenesis and management are similar to unstable angina.

- Variant Angina : This is an uncommon clinical syndrome characterized by coronary artery spasm, rest pain, reversible ST segment elevation, early morning attacks and ventricular arrhythmias or syncope in some patients. One fourth of patients have predominant coronary artery spasm in the absence of significant coronary atherosclerosis. These patients benefit most from treatment with calcium channel blockers and nitrates, while β -Blockers should be avoided. However, the majority of patients with variant angina have a fixed severe atherosclerotic stenosis. Those patients are managed similar to patients with unstable angina.

B-6.2 : Risk Stratification, Hospitalization and Monitoring

Patients can be classified into three categories based upon clinical findings associated with high or low risk for development of sudden death and nonfatal myocardial infarction.

1. High-Risk Features :

- Prolonged on-going > 20 minutes rest pain.
- Rest angina in the past 48 hours.
- Angina at rest with reversible ECG changes (ST depression or elevation ≥ 1 mm).

- Post-MI angina.
- Angina with hypotension, S3 gallop, or pulmonary congestion.
- Recurrent prolonged rest pain not relieved by nitroglycerine infusion.
- Malignant ventricular arrhythmias.

2. Moderate-Risk Features :

1. Prolonged rest angina > 20 minutes but relieved by nitroglycerine.
2. Nocturnal angina.
3. Age > 60 years, male gender, multiple risk factors for coronary atherosclerosis.
4. Associated carotid or peripheral atherosclerosis.
5. Recent onset angina less than 2 weeks.
6. Pathologic Q-waves of previous myocardial infarction or persistent ST depression ≥ 1 mm in multiple lead groups.

3. Low-Risk Features :

- No high or moderate risk features.
- Normal or unchanged ECG.
- Absence of rest pain in the past two weeks.

Risk stratification has an important bearing on the plan of management. Patients at low risk are put on an intensified medical regimen and managed on outpatient basis. They should be followed and reevaluated by stress testing within 72 hours.

Patients with high or moderate risk features should be hospitalized in the CCU to apply bed rest, parental medication, ECG monitoring and serial cardiac enzyme determination.

Early coronary angiography and revascularization procedures are indicated in patients with high-risk features, patients with prior myocardial infarction and left ventricular dysfunction, patients with previous coronary artery bypass graft surgery or PTCA and all patients who continue to have chest pain despite intensive medical treatment for 48 hours.

The remaining of patients hospitalized with unstable angina (> 80%) will become asymptomatic on medical treatment. These patients should undergo a submaximal exercise test before hospital discharge. Patients who show significant evidence of inducible ischemia are referred for coronary angiography.

B-6.3 : General Measures

These include sedation and alleviation of anxiety, treatment of aggravating factors (arrhythmias) and control of risk factors for coronary atherosclerosis.

B-6.4 : Medical Treatment

□ *Antiplatelet Drugs :*

Aspirin : Unless contraindicated, all patients with unstable angina should receive aspirin 160-324 mg/day. A chewable tablet is given as soon as the diagnosis is made. Aspirin therapy is associated with 50% reduction in mortality and nonfatal myocardial infarction.

Ticlopidine : In a dose of 250 mg bid this drug is a suitable alternative in patients with a contraindication to treatment with aspirin. It has a similar favourable effect on long-term prognosis.

Glycoprotein IIb/IIIa Receptor Antagonists e.g., Reo-Pro (Abciximab), tirofiban : This is a highly effective for prevention of death and myocardial infarction when administered in the form of IV infusion. It is expensive and not readily available in Egypt. Oral forms, e.g., orofiban are recently introduced.

□ *Anticoagulant Drugs :*

Heparin infusion in combination with aspirin should be started early in the course of unstable angina. The is continued for 2-5 days followed by SC heparin to avoid a rebound hypercoagulable state. It reduces the risk of nonfatal myocardial infarction and recurrent unstable angina. It also reduces the complications and improves the outcome of PTCA.

Low molecular weight heparin given SC in a dose of 1 mg/Kg every 12 hours has several advantages over regular heparin infusion with greater efficacy in reduction of cardiovascular events.

□ *Antiischemic Drugs :*

Nitrates : Nitroglycerine infusion for 24-48 hours is initially required in most hospitalized patients to improve myocardial perfusion and relieve chest pain. The dose should be titrated until symptoms are relieved or limiting side effects (hypotension) are observed. Patients should be switched to long-acting oral or topical preparations.

β -Blockers : In the absence of contraindications, β -Blockers should be administered to all patients in order to reduce myocardial oxygen demand and diminish the risk of myocardial infarction or sudden death.

Calcium Channel Blockers : Similar to nitrates, these drugs are used primarily to alleviate symptoms since

they lack an effect on prognosis. They are added to nitrates and β -Blockers as part of triple therapy for better control of chest pain. They are also indicated in variant angina or in the presence of a contraindication to β -Blockers and to control hypertension.

☐ Other Drugs :

Thrombolytic therapy has no benefit and maybe detrimental in the setting of unstable angina or non-Q myocardial infarction.

- LV Failure
- Cardiogenic Shock
- Ventricular Septal Rupture & Acute Mitral Regurgitation
- Hypertension During Acute MI
- Myocardial Ischemia After MI
- Pericarditis
- Arterial & Venous Embolism
- Ventricular Free Wall Rupture
- Aneurysms
- Right Ventricular (RV) Infarction

B-6.5 : Revascularization Procedures

Revascularization should be considered in all patients with high-risk features, patients with refractory angina and stabilized patients with a positive stress test.

In patients with suitable coronary anatomy PTCA results in rapid reversal of acute ischaemia, complete relief of symptoms and reduction of recurrent ischemic events. Patients with left main disease or multivessel disease and impaired left ventricular function are referred for coronary artery bypass graft surgery. Also diabetic patients are treated surgically.

Chapter 7 : The Diagnosis & Treatment of Acute Myocardial Infarction (MI) & Its Complications

B-7.1 : Introduction

B-7.2 : Diagnosis :

- History
- Physical Examination
- ECG
- Chest X-Ray
- Laboratory Tests
- Protocol for Early Diagnosis & Quick Response

B-7.3 : Therapy :

- Medication
- Activity
- Diet
- Psychological Support
- Pacing
- Cardioversion
- Associated Medical Disorders

B-7.4 : Preparation for Discharge

B-7.5 : Treatment of Specific Complications :

B-7.6 : Summary

B-7.1 : Introduction

MI is one of the most common life-threatening diseases and the first cause of death in most countries. It is often the result of coronary thrombosis. Mortality is highest during the first few hours. It is important to recognize MI quickly to admit the patient to the coronary care unit (CCU) and provide effective therapy. The last decade witnessed a revolution in therapy of acute MI with major impact on survival. The most notable of these is the routine use of intravenous coronary thrombolysis and the aggressive approach to recurrent ischaemia.

B-8.2 : Diagnosis

1. History :

Patients complain of chest discomfort that builds in intensity, eventually becoming severe and unrelenting. The pain frequently lasts for 30 minutes or more and is usually located in the region of the sternum, precordium, or epigastrium. Pain is usually characterized as constricting, crushing, oppressing, or compressing but may be stabbing, boring, knife-like, or burning. The discomfort often spreads to both sides of the anterior chest, with predilection for the left side. Pain of MI may radiate down the inner aspect of the left arm, left or both shoulders, the jaw or interscapular region. As many as 25% of patients with MI may have minimal or no chest discomfort. Patients are likely to complain of associated feelings of profound fatigue, cold sweats, dizziness, palpitation, and a sense of impending doom. The discomfort of MI may be confused with that of indigestion.

2. Physical Examination :

Patients often appear restless, ashen and apprehensive. The skin is usually cool and clammy. Respiratory

distress occurs in individuals with left ventricular failure. Sinus tachycardia is a sign of increased sympathetic nervous stimulation of the heart. It may be due to pain, agitation, hypovolemia, and left ventricular [LV] failure. BP may be normal, high, or low. A low-grade fever is common during the first two days. If right ventricular [RV] failure is present, (secondary to LV failure or RV infarction), jugular venous distention is evident. Chest examination may be normal or may reveal rales and rhonchi secondary to left ventricular failure. There is an S4 gallop

due to LV incompliance. The presence of an S3 gallop denotes more severe LV damage. Systolic murmurs may result from mitral regurgitation due to ischaemia, necrosis, or rupture of a papillary muscle or from LV dilatation. Rupture of the ventricular septum, which occasionally accompanies transmural septal infarction,

produces a loud holosystolic murmur. Pericardial rubs are heard only with transmural MI. Hepatomegaly is seen with RV failure. Peripheral edema occurs in patients with heart failure or associated venous disease. Neurologic deficits or peripheral vascular occlusions may follow embolization from LV mural thrombus.

3. ECG :
New Q waves or loss of R waves is the hallmark of Q wave [transmural] MI. Non-Q wave [nontransmural] MI may cause persistent S-T or T wave changes. ECG abnormalities are most specific when they are new. MI can occur in the absence of ECG changes. Localization of MI by ECG changes is summarized in the following table. ECG localization of MI is commonly inaccurate.

Site of MI	ECG leads
Anteroseptal	V ₁ -V ₄
Extensive anterior	V ₁ -V ₅₋₆
Lateral	I, aVL, V ₅₋₆
Inferior	II, III, aVF
Strict posterior	R waves in V ₁₋₂

4. Chest X-Ray :

Pulmonary congestion or edema occur in patients with increased LV filling pressures. Cardiomegaly implies LV dilatation, and is seen only with chronic LV dysfunction. Discrepancies occur between chest x-ray findings and the level of left ventricular filling pressure.

5. Laboratory Tests :

Serum Enzymes : (1) Creatine phosphokinase (CK). The MB iso-enzyme of CK (CK-MB) is particularly specific for myocardial cell injury. (2) Glutamic-oxaloacetic transaminase (GOT). (3) Lactic dehydrogenase (LDH). The LDH1 isoenzyme of LDH is more specific for myocardial cell injury than total LDH determination. The time frame of enzyme rise is given in this table :

Enzyme	Start of Rise	Peak	Back to Normal
CPK	6-8 hours	24 hours	3-4 days
GOT	8-12 hours	18-36 hours	3-4 days
LDH	24-48 hours	3-6 days	8-14 days

Newer Serum Tests : Injured myocardial cells release numerous intracellular components into the circulation. Particularly important markers of myocardial necrosis include troponins T & I and various pieces of the myosin and actin contractile apparatus.

Hematology : (1) White blood cell count rises soon after MI, receding after 2-3 days and returning to normal

within a week. The WBC count usually varies between 12,000 and 15,000 cells/micro-I, rarely reaching 20,000 cells/micro-I. (2) Erythrocyte sedimentation rate rises 48-72 hours after MI, peaking on day 4 or 5 and often remains elevated for 3 weeks or longer.

Other Tests: Plasma Na, K, Mg, Creatinine, Random glucose [RBS], Cholesterol [C] and Triglycerides [TG]

should be measured. MI may cause false high TG & false low C after 24 hours of onset of pain.

Echocardiography and Radionuclide Techniques : are detailed in other chapters.

Hemodynamic Monitoring : Flow-directed, balloon-tipped catheters can be placed with relative ease in the pulmonary artery of patients with acute MI. Current indications for hemodynamic monitoring in acute MI are :

- Unexplained hypotension.
- Severe LV failure.
- Suspected ventricular septal rupture or acute mitral regurgitation.

Differential Diagnosis of Acute MI: is discussed under clinical evaluation of chest pain.

PROTOCOL FOR EARLY DIAGNOSIS AND QUICK RESPONSE

1. Patient Evaluation in the emergency room [ER] should take no longer than 20 minutes from arrival. Aspirin [160 mg, soluble or chewable] is given to all patients with suspected MI.

2. Suggestive chest pain (within 12 hours) + ST elevation in 2 contiguous leads (III and a VF counted as one lead) or LBBB is an indication to start thrombolytic

therapy in the emergency room (in absence of contraindication). Thrombolysis saves lives in all ages and both sexes. Earlier administration leads to better results.

3. Diagnostic work-up for suspected acute MI :

a) Serum CK-MB (or at least CPK) q8h for 24 hours. Troponin-T testing if available.

b) With pain > 24 hours before admission, a daily serum LDH is ordered for 2 days. c) Daily ECGs for 3 days.

d) Radionuclide testing is performed on selected patients.

4. The diagnosis of MI is confirmed in any of the following situations :

1. Chest pain, ischemic in character + development of Q waves or loss of R waves on ECG. The diagnosis is confirmed by obtaining one or more abnormal serum enzyme determinations. The MB fraction of CK is the preferred enzyme.
2. Chest pain, ischemic in character + characteristic serum enzyme elevations. The ECG may reveal only S-T and T wave changes or left bundle branch block. The diagnosis is

more secure if radioisotope scintigraphy demonstrates a pattern consistent with MI.

3. Atypical symptoms [indigestion, syncope SOB, or unusual fatigue] + characteristic ECG changes (Q waves, loss of R waves, or persistent ST-T changes) + serum enzyme abnormalities. A radionuclide scintigraphic pattern, characteristic of infarction, may be substituted for electrocardiographic changes when the latter are absent or obscured by ventricular conduction delays such as left bundle branch block.
4. Typical or Atypical Symptoms (as just noted) + characteristic ECG changes (as just noted) + a radionuclide scintigram echocardiogram, or left ventricular angiogram characteristic of infarction.

B-7.3 : Therapy

1. MEDICATION :

Two aspirin tablets are chewed immediately following onset of chest pain.

- a. Thrombolytic Therapy : Recent attention has centered on the dissolution of the obstructing coronary thrombi which causes most MIs. If coronary thrombolysis is carried out successfully within 12 hours of the onset of symptoms of MI, the size of the resulting infarct as well as mortality will be reduced. The agents in common use are streptokinase (SK) and tissue plasminogen activator (TPA). These agents are infused IV. Reperfusion arrhythmias such as ventricular tachycardia (VT) are seen commonly at the moment that reperfusion is established. Following thrombolysis, patients should be treated with IV (or SC) heparin and aspirin. Following TPA administration, full IV heparin should continue for at least 72 hours. Commonly used thrombolytic regimens include 1,500,000 IU of streptokinase or 100 mg of TPA, administered IV over 1 hour. TPA is marginally more effective than SK, but is much more expensive, requires IV heparin for 3 days and produces more intracranial hemorrhage

(ICH) than SK. It is best preserved for patients who received SK previously or develop an allergy to it. ICH is a rare but serious complication of thrombolysis. It is more frequent with age > 70 years, hypertension, body weight < 70 Kg, and the use of TPA.

Primary angioplasty is a limited alternative to thrombolysis only in a hospital with an expert team that can start the procedure within about 1 hour after admission. An unlikely situation under local circumstances.

b. Anticoagulants :

1. All patients should receive Aspirin indefinitely.
2. Patients who have undergone thrombolysis should receive systemic IV or SC heparin for at least 3 days.
3. Systemic heparinization followed by 3-6 months of oral warfarin therapy is indicated in patients with cardiogenic shock, severe left ventricular failure, mural thrombus, and arterial or venous thromboembolism complicating (acute MI).
4. Low-dose or minidose heparin (5000 units SC bid or tid) is used routinely for all patients at risk of developing deep venous thrombosis.

c. Beta Blockers : Have been shown to reduce infarct size in experimental and clinical studies. In absence of contraindications, namely shock, more than grade I AV block, pulmonary oedema, beta blockers are given both intravenously, (atenolol 5 mg or Inderal 3-5 mg) and orally to all patients with acute MI. Strong indications are :

1. Early unstable angina after Q wave MI.
2. Sinus tachycardia with MI in absence of pain, hypovolemia and LV failure.
3. Non-Q wave MI with no heart failure.
4. Hypertension with acute MI.

d. Antiarrhythmics :

1. Ventricular ectopic beats (VPCs) > 5/minute, couplets or VT should receive antiarrhythmic therapy during the acute phase of MI. IV lidocaine is the usual first choice (bolus of 50-100 mg followed by infusion of 1-4 mg/min). Lidocaine dose should be reduced by 50% with hepatic dysfunction. Overdose can cause convulsions. IV followed by oral beta blockers (e.g., propranolol 1

mg IV bolus q 5 min guided by systolic BP which should not drop < 95 mmHg) is also very effective and safe for this indication. If ventricular ectopic activity persists, procainamide should be added (IV boluses of 100 mg q3-5min to a total of 1 gm followed by an infusion of 1-4 mg/min).

Procainamide is a peripheral vasodilator and may cause hypotension. A rare resistant case may require IV or oral amiodarone.

2. Atrial flutter, fibrillation, or tachycardia (without hemodynamic compromise) are treated with IV verapamil or digitalis. If these fail to revert the arrhythmia to sinus rhythm, quinidine (300-400 mg PO qid) or procainamide (500 mg IV bolus over 25 min followed by an infusion of 1-2 mg/min) may be tried for 24-48 hours.
 - a) 3. Chronic ventricular ectopic beats after MI are not shown to benefit from maintenance antiarrhythmic therapy. It is reasonable to treat patients in whom ECG monitoring shows non-sustained VT. Most class 1 agents are even harmful in this patient population, particularly when the LV ejection fraction (EF) is low (< 40%). Beta blockers and amiodarone are apparently the most safe and effective agents.
3. Patients with severe bradycardia with associated evidence of low cardiac output (hypotension, oliguria, drowsiness or clinical heart failure) should receive atropine (0.5-1.0 mg IV boluses q5-10 min to a total dose of 2 mg). If bradycardia persists, they need temporary transvenous pacing.

e. Vasodilators :

Indications :

1. Significant LV dysfunction (EF < 45%) with or without clinical signs of failure.
2. Large anterior MI (even with normal EF) :
Systolic BP should be >100 mm Hg. IV nitroglycerin (NTG) should be used with careful cuff BP monitoring. (IV NTG is also used with beta blockers to treat recurrent ischemia early after MI. It is no substitute for pain relief by narcotic analgesics). Angiotensin Converting Enzyme Inhibitors (ACEI) may be instituted as maintenance therapy. Patients with a contraindication to ACEI may be treated with hydralazine (25-50 mg PO qid) and long-acting nitrates. ACEI (Captopril 6.25-50 mg tid; Enalapril 2.5-10 mg bid) are effective in managing LV dysfunction and are shown to increase long-term survival in patients with reduced LVEF. They decrease the tendency of the infarct zone and the entire left ventricle to dilate following MI (i.e., they reduce LV remodeling). ACEI are best started during the first week of MI. The value of the routine use of ACEI in

uncomplicated inferior MI with normal LV function is not clear.

f. Analgesics & Sedatives :

Morphine (5-20 mg IV) and meperidine (Pethidine) (25-100 mg IV) are used to relieve the pain of MI, which results in activation of the sympathetic nervous system with potentially deleterious increases in heart rate and BP. Morphine is emetic. Opiates are contraindicated in liver dysfunction and recent stroke. Anxiety also activates the sympathetic nervous system. Patients should be sedated during the first week. A short-acting benzodiazepine is the tranquilizer of choice. A hypnotic such as flurazepam is often helpful, as well, for the first few days.

g. Stool Softeners and Laxatives :

Because the Valsalva maneuver decreases coronary blood flow, straining at stool should be avoided in post-MI patients. Sufficient bulk in the diet and stool softeners such as dioctyl sodium sulfosuccinate or a laxative should be part of all post-MI treatment.

Diuretics : h.

Patients who develop LV failure may need initially modest doses of furosemide (10-20 mg IV). Patients who fail to respond to this dose or with more severe degrees of LV failure (e.g., pulmonary edema) may need larger doses.

Digitalis : i.

Use of digitalis in acute MI is controversial. In absence of AF or gross LV failure and dilatation, it is better avoided.

Volume Therapy : j.

Patients with hypotension or sinus tachycardia whose venous pressure (clinically or by CVP line) is low or LV filling pressure (by pulmonary artery catheter) is < 18 mm Hg, should receive volume therapy to optimize the filling pressure. Colloid infusions such as plasma and dextran are preferred because they remain in the vascular space longer than crystalloid solutions.

Oxygen : k.

To correct arterial hypoxia, which commonly occurs in patients with MI, supplemental oxygen is recommended routinely (2-4 Lt/min).

2. ACTIVITY :

- a. Complete bed rest with bed-side commode (not bed pan) for 24-48 hours.
- b. Uncomplicated MI : Begin ambulation after 3 days and discharge in 5-7 days.

c. Patients with complicated MI may remain in the hospital for 2 weeks or longer.

3. DIET :

Nothing should be given by mouth for the first 6 hours, followed by clear liquids for 12 hours. Later, a diet of low calories, cholesterol, and saturated fat and rich in potassium and bulk should be offered.

4. PSYCHOLOGICAL SUPPORT :

Three psychological mechanisms operate in post-MI patients : anxiety, denial, and depression. A psychologically supportive environment is essential. Visit should be liberal unless needed for patient care. Open discussions with patient and family is needed to alleviate distress.

5. PACING :

Temporary transvenous pacing is indicated in:

- a. Any MI with sinus bradycardia or escape rhythm < 45 beats/min causing hemodynamic compromise.
- b. Anterior MI with Mobitz II, trifascicular block (bilateral BBB or BBB + long P-R interval or RBBB + left posterior hemiblock) or 3rd degree A-V block regardless of rate.

6. CARDIOVERSION :

DIC shock therapy is reserved for :

- a. VF and pulseless VT demand immediate cardioversion. The full output of the defibrillator is required to revert ventricular fibrillation, but 100 Jules are often sufficient to interrupt VT.
- b. Sustained tachyarrhythmia with hypotension, ischemia, heart failure, oliguria or drowsiness. Cardioversion should be performed under diazepam or short acting barbiturate anesthesia.
- c. Arrhythmias that fail to respond to antiarrhythmic medication.

7. ASSOCIATED MEDICAL DISORDERS :

Hypertension, diabetes mellitus, various forms of hyperlipidemia (especially types II and IV), gout, and COPD commonly accompany MI. These conditions should be sought and appropriate diagnostic and therapeutic measures instituted.

B-7.4 : Preparation for Discharge

- a. Exercise stress ECG test is recommended in absence of a contraindication. A sub-maximal test at 7-10 days or a symptom-limited test at 3-4 weeks should

be performed. Thallium exercise test and IV dipyridamole, adenosine, or dobutamine offer little advantage over the ordinary ECG test.

b. An estimate of LV function (echocardiography or radionuclide imaging) is of value in selected patients. Echocardiography is of lower cost and can detect mural thrombi and mechanical defects as septal and papillary muscle rupture.

These examinations can identify high risk patients who need further medical or revascularization therapy. They also help to plan rehabilitation & predict prognosis.

B-7.5 : Treatment of Specific Complications

a. LV Failure : Elevated LV filling pressure is almost universally present with acute MI. This can cause pulmonary congestion with transudation of fluid into the pulmonary interstitial space. The higher the LV filling pressure and the longer it remains elevated, the greater the amount of pulmonary interstitial fluid. In some individuals, signs and symptoms of LV failure are mild, requiring no therapy. In others, severe LV failure develops, necessitating vigorous treatment. Congestive lung symptoms require IV furosemide. After load reduction with IV NTG, ACEI or hydralazine and oral nitrate should be used. Hypotensive patients require either volume expansion, positive inotropes or both, depending on their LV filling pressure and cardiac output. LV failure is the most strong predictor of early and late mortality.

Cardiogenic Shock : The most severe form of LV failure following MI is cardiogenic shock. So much myocardium has been damaged that inadequate systemic perfusion occurs secondary to low cardiac output. The definition of cardiogenic shock requires : Systolic BP < 90 mm Hg + Organ hypoperfusion [low urinary output (<20-30 ml/h), cool, clammy skin, or mental obtundation].

Protocol for Action :

1. Exclude other causes of hypotension (hypovolemia, medications, arrhythmias, blood gas or electrolyte disturbances and marked bradycardia).
2. Insert pulmonary arterial, systemic arterial and urinary catheters to monitor therapy.
3. If LV filling pressure is > 18 mmHg and cardiac index is < 2.2 Lt/min/m², Dobutamine or dopamine should be infused in sufficient amount to keep systolic BP > 90 mm Hg and urine output is at least 30 ml/h.

4. Patients who require such support for > 24 h (or when severe shock is present from the outset) need intraaortic balloon counterpulsation or urgent coronary angioplasty or bypass grafting. Unfortunately, the majority of shock patients without mechanical defect (i.e., acute mitral regurgitation, ventricular septal defect) do not survive despite counterpulsation and cardiac surgery or angioplasty.

Ventricular Septal Rupture and Acute Mitral Regurgitation : c.

Sudden clinical deterioration accompanied by a loud systolic murmur is usually the result of rupture of the ventricular septum or part of a papillary muscle. The resultant volume overload placed on an already compromised LV generally produces severe LV failure with or without shock. Both diagnoses may be confirmed by bed-side echocardiography or pulmonary artery catheter readings of pressures and O₂ saturations. The patient may require pressors, diuretics, vasodilators, or intraaortic balloon counterpulsation to stabilize BP and relieve congestive symptoms. Patients who can be stabilized can undergo elective surgical repair a few weeks later at modest risk. Patients who require counterpulsation to maintain systemic perfusion must be operated on as soon as possible. Mortality from such surgery is high.

Hypertension During Acute MI : d.

If BP remains > 160/100 mm Hg after pain and anxiety have been relieved with analgesics, tranquilizers, and reassurance, one should strongly consider hypotensive therapy. If IV beta blockade fails to reduce blood pressure or is contraindicated, IV NTG, long-acting nitrate, oral beta blockade, an ACEI or a moderate diuresis with IV furosemide (10-20 mg IV bolus) should be considered. Short acting nifedipine is contraindicated, while the effect of long-acting calcium antagonists on mortality of acute MI is uncertain. The physician should attempt to lower the blood pressure to approximately 130-140/80-90 mm Hg.

Myocardial Ischemia After MI : e.

Anginal episodes during the immediate (1-3 week) post-MI period are considered unstable condition as they usually occur when the patient is rather inactive. Unless significant and overt LV failure is present, the patient should receive a beta blocker on a rapidly increasing dosage schedule : for propranolol, initiate 10 mg PO qid and increase to 20 mg qid and 40 mg qid on successive days. An even more rapid increase in dosage may be necessary in patients with recurrent anginal

episodes. Long-acting nitrates (orally or transcutaneous) are used. Patients with overt left ventricular failure may tolerate propranolol without further decompensation if digitalis is begun at the same time as propranolol. On the other hand, such patients may benefit from calcium channel blocker therapy (e.g., diltiazem 30-90 mg tid, or verapamil 80-120 mg tid). IV or SC full-dose unfractionated or low molecular weight heparin should be used. Failure to respond to adequate medical therapy calls for intraaortic balloon counterpulsation while preparing for urgent angiography. All patients with early myocardial ischemia or recurrent ST elevation should be considered for coronary angiography for possible revascularization.

Pericarditis : f.

Post-MI pericarditis can mimic post-MI angina. Usually the pain has some pleuritic or positional component. Evanescent or sustained pericardial rubs may be heard. Fever and even sinus tachycardia may be the result of pericarditis. Pericarditis with its attendant discomfort may occur soon after MI (1-5 days) or develop late in the convalescence (1-12 months). Aspirin (650 mg qid) is the drug of first choice. Indomethacin is used in refractory cases. Rarely, oral prednisone is needed. Weaning from steroids may be difficult, with multiple recurrences of pericarditis.

Arterial and Venous Embolism : g.

Arterial embolism from a LV mural thrombus and venous thromboembolism secondary to bed rest are uncommon but serious complications of MI.

1. Arterial Embolism :

IV heparin is given for 1-2 weeks, then oral warfarin for 2-6 months. For cerebral embolism anticoagulants are given only after a CT scan to exclude cerebral hemorrhage. Peripheral emboli are removed by a Fogarty embolectomy catheter.

2. Venous Embolism

is now unusual because of early ambulation and minidose heparin. Deep vein thrombosis or pulmonary embolism should be anticoagulated as in arterial embolism.

Ventricular Free Wall Rupture : h.

Ventricular free wall rupture is almost invariably fatal. Patients may have a normal ECG rhythm in the absence of any pulse or BP. Urgent pericardiocentesis and surgical repair is rarely useful.

Aneurysms : i.

LV aneurysms are circumscribed, noncontractile segments of LV wall. They usually occur months to years after MI and may be associated with significant LV failure or VT. When such problems

cannot be controlled medically, surgical excision is needed.

Right Ventricular (RV) Infarction : j.

Right ventricular infarction is not an uncommon complication of inferior and strict posterior MI. The cardinal features are high venous pressure, hypotension and ST elevation in right precordial leads [V3R, V1]. Tricuspid incompetence is common. Hypotension is common and it responds to volume loading with saline or colloids. The routine use of IV NTG is deleterious and vasodilator therapy has to be avoided in the acute phase. Healing usually occurs without residual chronic RV failure.

B-7.6 : Summary

Acute MI is the most common life threatening acute illness. Early diagnosis and treatment is important because :

1. Most deaths occur in the first few hours.
2. Early thrombolysis is life-saving. Immediate hospitalization is mandatory. Emergency room evaluation should take no more than 20 min. Patients with suggestive pain and > 1 mm ST elevation in 2 contiguous leads or LBBB should receive thrombolytic therapy followed by IV or SC heparin for 3days and Aspirin indefinitely. Pain should be relieved with IV narcotic analgesic. The CCU should have facilities for infusion drug administration, O2 therapy, defibrillation / cardioversion, endotracheal intubation, mechanical ventilation, hemodynamic monitoring and transvenous or transcutaneous pacing. In the CCU, ECG and vital signs are monitored for 48hours in uncomplicated cases. CK-MB is checked q 8hours thrice. K and Mg deficits are replenished. Patients need a tranquilizer, a stool softener and a hypnotic at night. Clear fluid diet is given during the first 12 hours followed by low fat high bulk diet. Ventricular arrhythmias require lidocaine, a beta blocker, procainamide, amiodarone or defibrillation / cardioversion.

Atrial fibrillation needs digoxin, verapamil, a beta blocker or cardioversion. Beta blockers should be given to all patients specially those with hypertension, inappropriate sinus tachycardia, recurrent ischemia and ventricular arrhythmia. ACE inhibitors are used for LV failure, asymptomatic systolic LV dysfunction and anterior MI. Long-term anticoagulation is indicated in severe LV failure, mural thrombus, chronic atrial fibrillation and arterial or venous thrombo-embolism. Recurrent ischemia calls for predischARGE angiography and subsequent necessary action. Otherwise, a predischARGE submaximal exercise ECG test can help in risk stratification and to plan rehabilitation.

Chapter 8 : Nitrates, Beta Blockers and Calcium Antagonists

I. Nitrates :

B-8.1 : Mode of Action

B-8.2 : Indications :

- 1) Sublingual Tablets or Oral Spray
- 2) Oral or Transdermal
- 3) Intravenous (IV) Infusion

B-8.3 : Side Effects and Complications

B-8.4 : Preparation and Doses

B-8.5 : Impact of Treatment on :

- a) Symptomatology & Quality of Life
- b) Survival
- c) Cost Effectiveness

II. Beta Blockers :

B-8.6 : Mode of Action

B-8.7 : Indications

B-8.8 : Preparation and Doses

B-8.9 : Side Effects & Complications

B-8.10 : Impact of Treatment :

- a) Symptomatology & Quality of Life
- b) Survival
- c) Recurrent Events
- d) Cost Effectiveness

III. Calcium Channel Blockers :

B-8.11 : Mode of Action

B-8.12 : Indications

B-8.13 : Preparation and Doses

B-8.14 : Side Effects & Complications

B-8.15 : Impact of Treatment :

- a) Symptomatology & Quality of Life
- b) Survival
- c) Recurrent Events
- d) Cost Effectiveness

1. NITRATES

B-8.1 : Mode of Action:

The standard first line therapy in patients with ischemic chest pain are nitrates.

All nitrates release nitric oxide which is identical with the endogenously produced endothelial derived relaxing factor (EDRF) secreted by the intact endothelium in response to various factors that call for coronary vasodilatation . Frequent administration of nitrates produce tolerance which is a significant clinical problem, this can be avoided by allowing a nitrate free interval of 8-10 hours/day.

Nitrates have both coronary and systemic vasodilator properties. They cause a redistribution of coronary blood flow along collateral channels and relieve coronary spasm. The systemic vasodilator action results in reduction of after load and especially in the preload leading to diminution of LV wall stress, which is a major determinant of myocardial oxygen requirements.

B-8.2 : Indications :

1. Sublingual Tablets or Oral Spray :

a. Abort an attack of angina.

b. As a prophylactic measure before any activity that may precipitate angina.

2. Oral or Transdermal :

a. In stable angina, nitrates reduce the frequency of attacks.

b. The peripheral hemodynamic effect of nitrates can be of benefit in patients with heart failure.

Oral and transdermal preparations are used as maintenance therapy to reduce the frequency of angina attacks.

3. Intravenous (IV) Infusion :

In acute coronary syndromes, i.e., unstable angina, acute myocardial infarction.

B-8.3 : Side Effects and Complications :

1. The most common side effect is headache, which diminishes with continuous use and development of nitrate tolerance.

2. Syncope can occur due to vasodilatation and hypotension, especially with high doses.

3. Because of the withdrawal rebound angina, IV NTG should be tapered gradually and never stopped suddenly.

B-8.4 : Preparation and Doses: (See table)

B-8.5 : Impact of Treatment

a. Symptomatology and Quality of Life:

Nitrates improve the quality of life by alleviating the symptoms of angina.

b. Survival :

There is no proven evidence of a beneficial effect on survival.

c. Cost Effectiveness :

Most of nitrate preparations are cost effective as they improve symptomatology at an acceptable cost.

2. BETA BLOCKERS

B-8.6 : Mode of Action

The beneficial effects of beta blocking drugs are primarily related to their potential to decrease myocardial oxygen needs. This is achieved by decrease in the heart rate, blood pressure and contractility. Exercise-induced increases in heart rate and blood pressure are also blunted. Through their antiadrenergic effects, they can prevent and treat arrhythmias secondary to sympathetic stimulation.

Relatively cardioselective beta blockers are competitive antagonist to of B1 receptor. Nonselective preparations such as propranolol block both B1 and B2 receptors, thus they may induce bronchospasm and precipitate claudication in susceptible patients.

B-8.7 : Indications

1. Beta blockers ameliorate angina. They are particularly effective when used in combination with nitrates.
2. Beta-blockers have been shown to reduce mortality if used in post myocardial infarction patients including asymptomatic patients.
3. Given in acute myocardial infarction parenterally and orally, they relieve pain and improve outcome.
4. They reduce blood pressure, they are recommended in hypertensive patients especially if associated with ischaemia
5. They are used in treating patients with arrhythmia associated with angina especially exercise induced arrhythmia.
6. A newly emerging class of beta blockers with vasodilator preparations are now in use (e.g., Carvedilol). They have a place in treatment of angina, hypertension and heart failure, especially in patients with peripheral vascular disease.

B-8.8 : Preparation and Doses : (see table)

B-8.9 : Side Effects and Complications

Major side effects include severe bradycardia, hypotension, bronchospasm and aggravation of heart failure. These side effects are uncommon if the patients are properly selected and if the dose is titrated gradually.

Absolute Contraindications :

1. Shock or severe hypotension.
 2. Heart block greater than Grade I.
 3. Pulmonary edema or a severe left ventricular systolic failure.
- Minor side effects include fatigue, lassitude, nightmares, cold extremities and impotence. Beta blockers should not

be stopped suddenly whenever possible. Taper over 1-2 weeks.

B-8.10 : Impact of Treatment

a) Symptomatology and Quality of Life :

Beta blockers ameliorate angina. They are effective in preventing ischemia, specially when used in combination with nitrates. Both drugs tend to abolish each other's side effects.

In emergency situation of acute ischaemic syndromes, specially if associated with tachycardia (but not heart failure) propranolol or metoprolol can be used by the intravenous route.

b) Survival :

Beta blockers have been shown to reduce mortality if used in post myocardial infarction patients. They have the potential to prevent death specially sudden death due to arrhythmias. Unless contraindicated, they should be used in all patients with or recovering from myocardial infarction.

c) Recurrent Events :

Beta-blockers reduce recurrent cardiac events through their action on the two sides of the demand / supply ratio. They reduce the oxygen demand of the heart by reducing the double product (heart rate x systolic blood pressure) and depressing contractility. At the same time, they improve the supply side of the equation by lessening exercise-induced vasoconstriction, tachycardia and improving myocardial perfusion as a result of the increased diastolic time. By opposing sympathoadrenal hyperactivity, they ameliorate vascular stress which can lead to plaque rupture and hence acute events in addition to suppression of platelet aggregation.

d) Cost Effectiveness :

Most of the beta-blockers are inexpensive and so they are cost effective. Some of the new types are relatively expensive like the vasodilator types.

3. CALCIUM CHANNEL BLOCKERS

B-8.11 : Mode of Action and Indications

These are a heterogeneous group of drugs that have the common effect of blocking calcium entry into the myocardial cell. They include the following classes : dihydropyridines (Nifedipine, Amlodipine),

phenylalkylamines (Verapamil) and benzodiazepines (Diltiazem). They cause coronary and peripheral vasodilatation. Thus, they both improve coronary perfusion and reduce the blood pressure. The last two classes may decrease the myocardial contractility and depress conduction.

B-8.12 : Indications

1. Chronic stable angina.
2. Vasospastic angina.
3. Angina with concomitant hypertension.
4. In angina with tachycardia or supraventricular arrhythmia (verapamil or diltiazem).
5. In resistant cases of angina in combination with beta blockers.

B-8.13 : Preparations and Doses : (See table).

B-8.14 : Side Effects and Complications

The major side effects vary with the agent and include :

- Tachycardia (with dihydropyridines, specially the short acting preparations). For this reason the short acting drugs have been largely abandoned.
- Heart failure and A-V block of various degree can result from the use of verapamil or diltiazem.

Other minor side effects are headache, pedal edema, flushing, dizziness and palpitations after dihydropyridines, e.g., constipation, especially in older patients with diltiazem and verapamil.

B-8.15 : Impact of Treatment

a) Symptomatology and Quality of Life :

Ca channel blockers are very effective in producing symptom relief in angina, particularly of the vasospastic type, or when associated with hypertension, tachycardia and arrhythmia. In all these conditions, it improves the quality of life and apart from minor side-effects which depend on the agent used, the patient feels better.

b) Survival :

There is no conclusive evidence that Ca-antagonist can reduce mortality in patients with angina or post-infarction patients. Short acting dihydropyridine derivative (nifedipine) can increase mortality in the post-myocardial infarction patient by inducing reflex tachycardia, so it is better avoided. Diltiazem was

shown to improve short term outcome after non-Q wave myocardial infarction.

c) Recurrent Events :

Survival studies showed verapamil, to be effective in the secondary prevention after acute myocardial infarction, as it reduces recurrent events and the need for hospitalization.

d) Cost Effectiveness :

By reducing recurrent events and the need for hospitalization, Ca antagonists decrease medical costs. The second generation of Ca-antagonists are relatively expensive and they should be restricted for special indications as in patients with impaired LV function, refractory angina, hypertension, intolerance or contraindications to beta blockers.

Chapter 9 : Antiplatelets, Anticoagulants and Thrombolytics

B-9.1 : Antiplatelet Drugs

I. Aspirin :

- a) Mode of Action
- b) Dose
- c) Indications
- d) Side Effects
- e) Clinical Value

II. Ticlopidine (Ticlid) :

- a) Mode of Action
- b) Dose
- c) Indications
- d) Side Effects
- e) Clinical Value

III. Glycoprotein IIb/IIIa Receptor Antagonists :

- a) Mode of Action
- b) Preparations
- c) Indications
- d) Side Effects
- e) Clinical Value
- f) Limitations

IV. Dipyridamol (Persantine) :

- a) Mode of Action
- b) Dose
- c) Indications
- d) Side Effects
- e) Clinical Value

B-9.2 : Anticoagulant Drugs

I. Heparin

- a) Mode of Action
- b) Preparation and Doses
- c) Indications
- d) Limitations
- e) Clinical Value

II. Low Molecular Weight Heparin (LMWH)

- a) Mode of Action
- b) Preparation and Dose
- c) Indications
- d) Clinical Value

III. Oral Anticoagulant Drugs

- a) Mode of Action
- b) Preparation and Doses
- c) Side Effects
- e) Clinical Value

B-9.3 : Thrombolytic Agents

- a) Mode of Action
- b) Preparation and Doses
- c) Indications
- d) Contra Indications

e) Limitations and Side Effects

- f) Clinical Value

ANTIPLATELET DRUGS

Antiplatelet agents with documented antithrombotic effect which are used in clinical practice include : Aspirin, Dipyridamol (Persantin), Ticlopidine and GP IIb/IIIa antagonists.

ASPIRIN :

Mode of Action : It exerts its action by acetylating and inactivating cyclooxygenase enzyme responsible for thromboxane A₂ generation.

Dose : The dose varies from 75-350 mg/day oral tablets. Patients with acute coronary syndromes should receive 150 mg.

Indications :

1. Unstable angina
2. Acute myocardial infarction
3. Primary and secondary prevention of myocardial infarction
4. Coronary angioplasty and stenting
5. After coronary artery bypass graft surgery

Side Effects :

Gastrointestinal disturbances and bleeding, these are dose related, i.e., more common with high doses. Hypersensitivity reaction in the form of bronchial asthma, skin allergy reactions and angioneurotic edema.

Clinical Value :

Aspirin reduces cardiovascular mortality and nonfatal myocardial infarction in patients with coronary artery disease.

II. TICLOPIDINE (Ticlid) :

A. Mode of Action : It blocks ADP-induced platelet aggregation. Onset of its therapeutic effect is delayed for 2-3 days.

B. Dose : It is given in 250 mg tablets twice daily after meals. Blood picture should be frequently monitored.

One)Indications :

- As an alternative drug to aspirin in patients with unstable angina when there is contraindicated to aspirin, specially in patients with transient ischemic attacks.
- Coronary artery stenting.

Two)Side Effects :

- Neutropenia and thrombocytopenia in 4% which are reversible upon drug withdrawal.
- Gastrointestinal symptoms.

Three)Clinical Value :

Four)Ticlopidine was shown to reduce cardiovascular mortality and myocardial infarction in patients with unstable angina.

Five)It reduces the incidence of stent thrombosis.

III. GLYCOPROTEIN IIb/IIIa RECEPTOR ANTAGONISTS :

- Mode of Action : It blocks the platelet GP IIb/IIIa receptors which bind fibrinogen, thus preventing platelet aggregation.
- Preparations : Tirofiban, Integrelin and Abciximab administered as intravenous infusion. Oral forms are also available, e.g., Orofiban.
- Indications :
As an adjunct to thrombolytic therapy in AMI.
Unstable angina.
High-risk PTCA.

Six) *Side Effects* :

Bleeding complications.

1. *Clinical Value* :

These drugs reduce the rates of non-fatal MI, mortality, recurrent ischemia and need for revascularization procedures in patients undergoing coronary angioplasty, and in patients with unstable angina or non-Q MI.

Limitations :

Very expensive drugs.

Long term administration may be necessary.

IV. DIPYRIDAMOL (Presantine) :

Four) *Mode of Action* : It is a phosphodiesterase inhibitor that inhibits platelet function through an increase in cyclic AMP.

Five) *Dose* : It is given in 250 mg tablets twice daily after meals. Blood picture should be frequently monitored.

Six) *Indications* : The only current indication is in some patients after bypass graft surgery.

Seven) *Side Effects* : Gastrointestinal.

Eight) *Clinical Value* : It has a limited value in the management of coronary artery disease.

ANTICOAGULANT DRUGS

Nine) HEPARIN :

Six) *Mode of Action* : Heparin is available either as standard unfractionated heparin or as low molecular weight heparin. The pharmacologic action of heparin is mediated through interaction with the natural anticoagulant antithrombin III leading to inhibition of thrombin, factors IXa and Xa.

Preparation and Doses : IV heparin is started as a bolus of 5000 IU followed by an infusion of 1000-1500 IU/hr, adjusted to maintain an activated partial thromboplastin time of 1.5-2.5 times the control value. SC heparin is given as 5000 units q 8 hours or 12500 units q 12 hours.

Seven) *Indications* :

- Acute myocardial infarction
- Unstable angina
- PTCA
- Venous thromboembolism

One) *Limitations* :

- Bleeding with overdose
- Thrombocytopenia
- Rebound hypercoagulable state upon sudden discontinuation
- Poor bioavailability, highly variable response and a short duration of action.

A. *Clinical Value* :

- Adjunctive heparin therapy is usually given after thrombolytic therapy in acute MI.
- Heparin reduces the incidence of myocardial infarction in patients with unstable angina.
- Heparin reduces the complications of PTCA.
- It reduces the incidence of thromboembolism in patients with large myocardial infarction.

One) LOW MOLECULAR WEIGHT HEPARIN (LMWH) :

Two) *Mode of Action* : LMWH consists of fragments of commercial standard heparin having smaller molecules. Like regular heparin, LMWH interacts with antithrombin III, however, it has a greater inhibiting effect on factor Xa. It has superior

bioavailability, a longer duration of action and a more predictable anticoagulant response. It is given by SC route. It is also associated with a lower incidence of bleeding and thrombocytopenia.

Preparation and Doses : Enoxoparin (LMWH available in Egypt) is given SC in a dose of 1 mg/Kg body weight q 12 hours. It does not need laboratory monitoring.

Three)**Indications** : Similar to heparin.

Four)**Clinical Value** : LMWH was shown to reduce death, myocardial infarction and recurrent angina in patients with unstable angina and non-Q myocardial infarction. It has an established role in prophylaxis against deep venous thrombosis.

III. ORAL ANTICOAGULANT DRUGS

:

Mode of Action : Oral anticoagulants act by inhibiting the vitamin K reductases, as a result the function of the vitamin K dependent coagulant proteins, prothrombin, factors VII, IX and X is impaired.

B. Preparation and Doses : Warfarin sodium is initially administered in a dose of 5-10 mg/day for 48 hours to be adjusted to alter the prothrombin concentration to a range of 30% and INR of 2-3. The maintenance dose varies widely between individual patients (range 1-10 mg/day, adjusted according to prothrombin concentration and INR (International Normalized Ratio)).

One)**Indications** :

Two)Venous thromboembolism.

Three)Auricular fibrillation.

Four)Mural thrombus after acute myocardial infarction.

Five)Large myocardial infarction with impaired LV function or dilated left ventricle.

Six)Selected patients with unstable angina.

Two)**Side Effects** :

- Bleeding due to hypoprothrombinemia.

- Rebound hypercoagulability.

Three)**Clinical Value** : Oral anticoagulants are of proven efficacy in prophylaxis against venous thromboembolism and embolization from cardiac chamber thrombi.

THROMBOLYTIC AGENTS

- Mode of Action : They act by converting the proenzyme plasminogen to the active enzyme plasmin which dissolves (lyses) the fibrin clot. They also degrade coagulation factors V and VIII interfering with further fibrin production. After administration of thrombolytic agents, plasma fibrinogen level decreases and fibrin degradation products increase.

- Preparation and Doses :

Four)**STREPTOKINASE** : The administration of 1.5 million units of SK in one hour takes a median of about 90 minutes from the start of treatment to open the occluded coronary artery. It should be preceded by 100 mg hydrocortisone IV.

Five)**TISSUE PLASMINOGEN ACTIVATOR**

(**T-PA**) : Tissue plasminogen activator is synthesized using recombinant DNA technique. It is an expensive preparation.

Six)**Indications** :

In absence of clear contraindications, all patients presenting with acute MI (i.e., chest pain associated with ST segment elevation or recent left bundle branch block) should receive thrombolytic therapy as early as possible within 1-3 hours of onset of symptoms. The therapeutic benefit extends up to 6-12 hours.

Seven)**Contra Indications** :

- Prior intracranial bleeding.
- Thromboembolic stroke within two months.

- Neurosurgery or head injury within one month.
- Active internal bleeding.
- Dissecting aortic aneurysm.

1. *Limitations and Side Effects :*

Three) Haemorrhagic complications as intracranial hemorrhage in 0.4%, especially in patients above 75 years of age.

Four) Streptokinase restores adequate coronary perfusion in about 50-60% of patients within 90 minutes. 20% of patients with successful reperfusion will develop early reocclusion as a result of reactivation of thrombin and platelets.

1. *Clinical Value :*

Thrombolytic therapy substantially reduces cardiovascular mortality in all patients with MI, irrespective of patient age, sex, location of infarction, presence of heart failure or diabetes mellitus. However, they produce complete recanalization in less than 50% of patients. It has no proven benefit in acute myocardial infarction with ST depression.

Chapter 10 : PTCA and Related

Procedures

2-11.1 : Rationale for Clinical Application

2-11.2 : Indications and Complications for PTCA

2-11.3 : Cost Effectiveness

2-11.4 : Misuse and Prohibited Practice

B-10.1 : Rationale for Clinical Application

As a method of myocardial revascularization, PTCA and related techniques have become the method of choice for treatment of increasing numbers of patients with CAD. They are associated with a high rate of success and low incidence of life threatening complications. The success rates are closely related to the operator experience, excellent angiographic equipment and availability of suitable means of managing complications. The correction of complex lesions often requires additional

expensive tools such as rotablator and atherectomy devices.

The introduction of stents and effective antithrombotic therapy resulted in a reduction of the rate of complications and allowed the successful treatment of high risk cases.

B-10.2 : Indication and Complications for PTCA

Indications :

Five) Stable angina due to significant stenosis of one or more coronary vessels resulting in a large or moderate area of viable but ischemic myocardium with failure of optimal medical therapy.

1. Unstable angina failing to respond to intensive medical therapy and associated with significant stenosis suitable for PTCA.

Six) Acute myocardial infarction in the following situations :

- Immediately after failed thrombolysis (Rescue PTCA)
 - Elective PTCA for those with recurrent episodes of ischemia after recovering from acute MI.
 - Cardiogenic shock. In this case it must be done under cover of haemodynamic support, by inotropic drugs and intra-aortic balloon pump.
 - Primary PTCA as the immediate line of therapy for acute and evolving MI without thrombolysis. This indication is only limited to highly specialized centers.
- Complications :
- Abrupt closure of the coronary artery.
 - Elastic recoil at the site of lesion.
 - Coronary dissection and rarely perforation.
 - Myocardial infarction.
 - Bleeding complications.
 - Local vascular complications.

- Ideally a surgical back-up is needed to deal with complications needing urgent surgical intervention. However, this is rare.

B-10.3 : Cost Effectiveness

This procedure is expensive. Because of the high incidence of restenosis, many patients need repeat procedures or further interventions with additional expenses. Selection of the cases should be the job of an experienced senior cardiologist and it is better to be done in tertiary care fully equipped hospital. The choice of equipment should be selective to suit the requirements of the unit, patient and economy of the country.

B-10.4 : Misuse and Prohibited Practice

It is time to put rules and regulations on the practice of interventional procedures by the Egyptian Society of Cardiology and the Egyptian Medical Syndicate to prohibit the practice of untrained or insufficiency trained interventional cardiologists. The minimal training requirements are : Performing 500 diagnostic cardiac catheterizations, assisting in 100 cases of PTCA, and performing 30 cases of PTCA under supervision of a senior interventional cardiologist. See section on “Recommendations.”

Chapter 11 : Risk Stratification After

Acute Myocardial Infarction

C-11.1 : Definition & Importance

C-11.2 : Methods of Risk Stratification

C-11.3 : Clinical Evaluation

C-11.4 : Noninvasive Testing

C-11.5 : Detection of Life-Threatening Ventricular Arrhythmias

- f) Ambulatory Electrocardiography
- g) Signal Averaged Electrocardiography
- h) Electrophysiologic Testing

C-11.6 : Coronary Angiography

C-11.1 : Definition and Importance

Patients who developed myocardial infarction are at a substantial risk of recurrent cardiovascular events (sudden death, congestive heart failure and infarction).

Risk stratification helps to identify patients at high risk in order to improve their prognosis by aggressive diagnostic tests, medication and interventions.

C-11.2 : Methods of Risk Stratification

The prognosis after myocardial infarction is determined by three major variables :

1. Left ventricular function
2. Residual myocardial ischemia
3. Life-threatening ventricular arrhythmias

These prognostic factors can be assessed by the following methods before hospital discharge :

Clinical evaluation

Noninvasive testing

Coronary angiography.

C-11.3 : Clinical Evaluation

The following features identify patients at high risk :

- Age over 70 years
- Large anterior myocardial infarction
- Congestive heart failure
- Previous myocardial infarction
- Post-infarction angina (> 24 h after onset) associated with ECG changes.
- Spontaneous sustained ventricular tachycardia.
- Delayed in hospital cardiac arrest.
- High degree A-V block with anterior myocardial infarction.

C-11.4 : Noninvasive Testing

Studies of Left Ventricular Function :

Echocardiography should be performed in all patients who sustained an acute myocardial infarction. The following are major predictors of survival :

- Depressed left ventricular ejection fraction
- Increased end systolic volume.

The following table shows the strong relationship between left ventricular ejection fraction and mortality at 2 years :

EF %	Mortality %
≥ 40	5
30-39	10-15
< 30	20-25

Exercise ECG :

Asymptomatic patients who do not have high-risk clinical features are candidates for submaximal exercise testing before hospital discharge and maximal exercise at 3-8 weeks afterwards. The following variables indicate a high-risk exercise test (refer chapter 2) and merit the referral of patients to coronary angiography :

- Inability to complete stage I of Bruce protocol.
- Hypotension during exercise.
- ST depression ≥ 2 mm, ≤ 3 minutes of Bruce Protocol.
- ST elevation in non-Q wave leads.
- Low achieved heart rate < 120 beats/minute in absence of medication.

One) Exercise - Thallium - scintigraphy or

stress echocardiography can be used as an alternative test in patients with resting ECG abnormalities (LBBB, on digitalis, pacemakers, ventricular hypertrophy) that would interfere with exercise ECG testing interpretation. Large reversible perfusion defects specially if multiple, involving more than one region and with increased lung uptake indicate high risk nuclear studies.

C-11.5 : Detection of Life-Threatening Ventricular Arrhythmias

The presence of malignant ventricular ectopic activity in patients after myocardial infarction is associated with a greater risk of subsequent cardiac events, most notably sudden death. Patients with reduced EF are particularly at high risk. The following methods have been utilized for risk stratification of such patients.

a) *Ambulatory Electrocardiography* : (*Holter Monitoring*)

Frequent premature high grade ventricular complexes on Holter monitoring is helpful in risk stratification of symptomatic patients.

1. *Signal Averaged Electrocardiography* :

Following myocardial infarction, the finding of low amplitude late potentials together with an increased filtered QRS duration greater than 120 ms has a positive predictive value of 8 - 27% and a negative predictive value of 96 - 99% for future arrhythmic events (VT or sudden death).

2. *Electrophysiologic Testing* :

The inducibility of sustained monomorphic ventricular tachycardia in patients with two or more of the following : ejection fraction < 40 %, ventricular late potentials and high grade ventricular ectopy indicate poor prognosis. High risk patients (with the above characteristics) having inducible ventricular tachycardia should be considered for drug therapy guided by electrophysiologic testing or implantable cardioverter defibrillator or empirical amiodarone.

C-11.6 : Coronary Angiography

Early coronary angiography after acute myocardial infarction should be performed in the following patients :

3. Patients with high risk clinical features including these with recurrent myocardial ischaemia, left ventricular dysfunction or cardiogenic shock.
4. Patients with inducible ischaemia on stress testing. Asymptomatic patients who have a negative stress test are at very low risk, (predicted annual mortality of 1-3 %), coronary angiography has no role since it will add little to their management and prognostic outcome.

Chapter 12 : Coronary Heart Disease in Women

C-12.1 : Epidemiology

C-12.2 : Peculiarities in Etiology and Pathogenesis

- 1) Lipid Profile
- 2) Tobacco Use
- 3) Hypertension
- 4) Diabetes
- 5) Estrogen & Premenopausal Protection

C-12.3 : Peculiarities in Clinical Presentations

C-12.4 : Peculiarities in Diagnostic Investigations

C-12.5 : Peculiarities in Management

- a) Medical Treatment
- b) Thrombolysis for Acute Myocardial Infarction
- c) Angioplasty
- d) Coronary Artery Bypass Graft Surgery

C-12.6 : Prevention

C-12.1 : Epidemiology

Coronary heart diseases remains a leading cause of death in women. Its morbidity and mortality in women is similar to that of men ten years younger. The incidence of the disease is significantly lower in premenopausal women but it rises after menopause.

C-12.2 : Peculiarities in Etiology and Pathogenesis

The prevalence and effects of risk factors contributing to the pathogenesis of CAD are different in women.

1. Lipid Profile :

There is no gender difference in plasma lipids till puberty. After the age of 50 years and menopause, the LDL Cholesterol increases in women and may exceed its level in men of similar age. HDL, on the other hand declines slightly after menopause.

2. Tobacco Use :

In Egyptian women, cigarette smoking is uncommon. In Western countries, more than 50% of myocardial infarctions occurring in middle aged women are attributable to smoking.

3. Hypertension :

Essential hypertension is less common before menopause in women than men, while the reverse is true after menopause. About 60% of Egyptian women have systemic hypertension after the age of 60 years (Egyptian NHP Data).

4. Diabetes :

Diabetes mellitus is associated with a 3-7 fold elevation of CAD risk in women compared with only 2-3 fold increase in men.

5. Estrogens and Premenopausal Protection :

Natural estrogens affect lipids favourably. They improve endothelial function and coronary vasomotor tone, while decreasing fibrinogen, glucose and insulin level.

C-12.3 : Peculiarities in Clinical Presentations

Angina pectoris is the dominant clinical presentation in women with CAD. This contrasts with men who present more often as myocardial infarction.

Atypical chest pains are more common in females and these are more likely to be associated with normal coronary arteries. The lower prevalence of CAD in women and the higher prevalence of non-coronary causes of chest pain (e.g. Mitral valve prolapse), lead to a high rate of false positive diagnosis of CAD in women with chest pain.

On the other hand, the first coronary event is more often fatal in women than in men. Following a myocardial infarction women have more anxiety, depression, and return to work less often than men.

C-12.4 : Peculiarities in Diagnostic Investigations

Women are subjected to diagnostic procedures for CAD less often and at a later stage of the disease than men. In addition, non-invasive studies, are less reliable in females.

Exercise ECG has many false positive results because females are less likely to achieve an adequate heart rate response and are more likely to have repolarization abnormalities and excessive sympathetic stimulation. Radionuclide perfusion studies, improve the diagnostic accuracy but breast shadow may also cause a false positive result. Dobutamine stress echocardiography causes less false positive results than exercise ECG and nuclear studies.

Angiography shows a higher incidence of coronary vasospasm and microvascular disease than men.

C-12.5 : Peculiarities in Management

In general, women are less likely to be offered thrombolysis, angioplasty or coronary artery surgery than men.

a) Medical Treatment :

Because women have a different endocrine response from men, their medication effects may differ. For example, women describe more side-effects from Beta blocking drugs than men. Women's reduced body mass may result in a relatively greater drug-dose effect.

Women with hypertension live longer than men. The same guidelines for treatment of hypertension are considered appropriate for men and women.

Because women, in general, have smaller coronary arteries related to their smaller body size, fluctuations in coronary tone may be of increased importance. This suggests that nitrates and calcium antagonists may have added value.

b) Thrombolysis for Acute Myocardial

Infarction :

Thrombolysis is equally effective in women and men. However, females sustain a greater risk of cerebral hemorrhage as a complication of this therapy.

c) Angioplasty :

This is more commonly used in females than surgery. However, the results of angioplasty are poorer in females than males due to their smaller vessels and more extensive disease. On the other hand, when successful, late results of angioplasty are the same in both sexes.

d) Coronary Artery Bypass Graft Surgery :

CABG is followed by a higher mortality in females. This may be due to their older age, smaller coronary arteries and more extensive disease resulting in less complete revascularization and to the higher prevalence of associated diabetes mellitus. The internal mammary artery is less often used for grafting in women due to its small size.

C-12.6 : Prevention

Control of risk factors is applicable to women as a method of primary or secondary prevention of CAD. Hormonal replacement therapy by natural estrogen in post menopausal women causes definite reduction of cardiac events. However, their value must be evaluated against their possible role in increasing the incidence of endometrial and breast malignancies.

Chapter 13 : Prevention of Coronary

Artery Disease

C-13.1 : Levels of Prevention

- 1) Primordial Prevention
- 2) Primary Prevention
- 3) Secondary Prevention
- 4) Tertiary Prevention

C-13.2 : Classification of Risk Factors

C-13.3 : Individual Preventive Measures

- a) Diet
- b) Tobacco Use
- c) Dyslipidemia
- d) Hypertension
- e) Diabetes Mellitus & Insulin Resistance Syndrome
- f) Physical Inactivity
- g) Obesity
- h) Other Measures

About two thirds of deaths secondary to coronary artery disease occur outside hospital and before receiving any effective medical assistance. This fact underscores the role of prevention in order to decrease fatalities secondary to CAD.

Epidemiologic studies have identified risk factors that increase the likelihood of developing coronary atherosclerosis and enhancing the progression of established ischemic heart disease. These studies have also shown that management of these risk factors can delay the onset, stop the progression or even cause mild regression of atherosclerotic lesions. It also can prevent disruption of the atherosclerotic plaque and so reduce the morbidity and mortality of coronary heart disease. Identification and management of risk factors is the core of the preventive measures. In addition, some therapeutic measures were found useful in reducing morbidity and mortality of coronary artery disease even though they do not affect the risk factors e.g. aspirin and beta blocking drugs and angiotensin converting enzyme inhibitors.

C-13.1 : Levels of Prevention

Four levels of prevention can be identified corresponding to different phases in the development of disease : primordial, primary, secondary and tertiary. All are important and complementary although primordial and primary prevention have the most to contribute to health and well-being of the whole population.

Two) *Primordial Prevention* :

This means preventive measures addressing the population at large.

The aim of primordial prevention is to avoid the emergence and establishment of patterns of living that are known to contribute to an elevated risk of the disease.

In Egypt, CAD is increasingly becoming important in the urban population groups, which have already acquired high risk behavior. As socioeconomic development occurs, the risk factors can be expected to become more widespread leading to a major increase in CAD.

Primordial prevention for CAD should include national policies and programs on food, nutrition, comprehensive policies to discourage smoking, programs for prevention of hypertension and programs to promote regular physical activity.

Three) *Primary Prevention* :

The purpose of primary prevention is to limit the incidence of the disease by controlling causes and risk factors in people at high risk, (the high risk strategy).

1. *Secondary Prevention* :

Directed to patients with clinical evidence of the disease to delay or prevent progression and recurrences. e.g., aspirin and beta blockers to patients who had sustained a myocardial infarction.

1. *Tertiary Prevention* :

Aimed at reducing the progress or complications of established disease and is an important aspect of therapeutic and rehabilitation medicine. Tertiary prevention is often difficult to separate from treatment since the treatment of chronic disease has, as one of its central aims, the prevention of complications.

C-13.2 : Classification of Risk Factors

Risk factors can be classified into :

a) Modifiable e.g. smoking, hypertension, dyslipidemia, diabetes, obesity and sedentary life style.

b) Non modifiable e.g. age, male gender, and family history of premature CAD. Risk factors are synergistic so that when they co-exist they increase the overall risk several folds. Consequently the presence of unmodifiable risk factors necessitates more intense management of the modifiable factors.

The major risk factors which contribute greatly to the development of morbidity and mortality of CAD and for which interventions have been shown to reverse their deleterious effects are :

1. Smoking
2. Dyslipidemia
3. Hypertension
4. Diabetes
5. Other potentially correctable risk factors include physical inactivity, obesity, hemostatic factors, hyperhomocystinemia, stress and type of personality.

C-13.3 : Individual Preventive Measures

a) Diet :

Healthy dietary habits are important elements in CAD prevention even in persons with normal serum lipids. The recommended diet should have the following characteristics :

1. Calories to maintain ideal body weight, and avoid obesity.
2. Reduced salt and sodium content.
3. Reduced total fats, especially saturated fats and cholesterol.
4. Plenty of fruits and vegetables.
5. Rich in fiber containing food, e.g., vegetables, legumes, bran, grains.

b) *Tobacco Use* :

Tobacco use has been associated with lower levels of HDL cholesterol, higher levels of LDL cholesterol and triglycerides. It elevates carbon monoxide and catecholamines in the blood. Acute smoking elevates blood pressure.

A strong dose-related relationship has been found between CAD and number of cigarettes smoked per day. This applies to all ages and to both sexes. There is no evidence that filters reduce this risk. Pipe and cigar smoking, when not inhaled, carry a smaller risk. Passive smoking, i.e., being exposed to the smoking of others is also harmful. Cessation of smoking leads to marked fall in coronary events and the risk declines to normal level in two years.

The physician should institute the following measures in his smoking patients :

- 1) Firmly discourages his patients from smoking,
- 2) Schedule a time plan for cessation of smoking with follow up visits to ensure adherence.
- 3) Advise the patients on the use of nicotine substitutes such as the nicotine gum and skin patches.

c) Dyslipidemia :

Elevated serum cholesterol has conclusively been shown to have direct continuous relationship to incidence of CHD. This applies to normal healthy subjects and to those who already sustained myocardial infarction. Serum cholesterol as well as low density lipoprotein cholesterol (LDL) can be elevated by genetic predisposition, e.g. familial hypercholesterolemia or by excessive ingestion of saturated fats or high cholesterol-containing foods. LDL cholesterol is the main harmful fraction and it acts to accelerate the development of atherosclerotic lesions, plaque formation, endothelial dysfunction and finally, plaque instability and disruption. Low HDL cholesterol also appears to be an independent risk factor. Hyper-triglyceridemia is also harmful specially in women.

Lowering elevated total and LDL cholesterol by whatever means (diet, exercise, drugs) causes reduction in morbidity and mortality in all patients with ischaemic heart disease whether the serum lipids are markedly or only slightly elevated, i.e., secondary prevention. This preventive benefit is also observed in healthy individuals with elevated serum lipids, i.e., primary prevention. A serum level below 200 mg per dl total cholesterol or below 130 mg per dl LDL cholesterol and 200 mg of triglycerides is desirable and it should be achieved first by diet and if this fails, then by drugs, specially in high risk groups. Patients with established ischaemic heart disease are at particularly higher risk and the maximal acceptable levels are : 200 and 100 mg per dl for total serum cholesterol and LDL cholesterol respectively. In addition, owing to the harmful interaction between various risk factors, persons who are free of ischemic heart disease but have two or more risk factors (e.g. male gender, family history, smoking, hypertension, etc.) should also be treated if their total cholesterol and LDL cholesterol levels are above 200 and 130 mg respectively.

Dyslipidemias should be corrected in the following way :

4. Dietary measures must be used first to achieve ideal body weight and to decrease the dietary consumption of saturated fatty acids. The recommended daily intake of total fat should be less than 30% of the caloric intake with less than 10% of the calories coming from saturated fats. This corresponds to an average of 25 gm saturated fats (samna or butter) plus 25 gm oils containing poly

unsaturated fatty acid, (e.g. corn oil) and 25 gm oil containing mono unsaturated fatty acid, (e.g., olive oil). Dietary measures should be implemented for a period of 3 months unless the patient has CAD when pharmacologic therapy is to be added. Dietary measures should be continued even after the use of hypocholesterolemic drugs.

5. Drugs are added if the diet fails to achieve the desirable levels of plasma lipids. If the main abnormality is hypercholesterolemia then one member of the statins group should be the first choice. Alternative but less effective are nicotinic acids, and cation exchange resins. If the main abnormality is hypertriglyceridemia one of the fibrates or nicotinic acid is usually the first choice.

d) Hypertension :

Several major epidemiologic studies have proved that both systolic and the diastolic hypertension have a strong positive relationship to incidence and mortality of coronary heart disease. This rise in risk is more apparent if hypertension is associated with any other risk factor. Elevation of systolic blood pressure is at least as important as the elevation of diastolic blood pressure. Reduction of blood pressure to normotensive levels is indicated in all persons irrespective of whether they have already developed ischaemic heart disease or not. The maximum acceptable level is generally taken to be 140/90 mmHg. Lower levels of 130/85 are recommended in specific high risk persons e.g. diabetics.

e) Diabetes Mellitus and Insulin Resistance Syndrome :

Resistance to insulin stimulates compensatory hyperinsulinemia and is associated with a group of coronary risk factors including hypertension, diabetes, hypertriglyceridemia, and low high density lipoprotein cholesterol. All these lead to early development and rapid progression of atherosclerotic CAD. Insulin resistance can be partially corrected by weight loss and physical activity.

Both insulin dependent and non insulin dependent diabetes increases the risk of developing coronary heart disease. In diabetics, tight control of blood sugar, exercise, limitation of carbohydrates and saturated fats in diet as well as caloric restriction are definitely recommended.

f) Physical Inactivity :

Physical inactivity increases the risk of coronary heart disease. Physical activity produces a favorable effect on several other risk factors such as diabetes, hypertension and obesity. It is recommended that every adult should exercise for at least 30 minutes/day. It is also

recommended that patients with ischaemic heart disease should have at least 30 minutes of moderate intensity activity, e.g., brisk walking, bicycling three to four times a week. Strenuous physical activity is not required to achieve mortality benefit.

Exercise should be individualized to accommodate the patient's level of physical fitness, cardiac status and preferred activities.

For patients with established ischaemic heart disease, exercise testing is recommended before initiating an exercise program.

g) Obesity :

Obesity is defined as body mass index (i.e. weight in kg/height in m²) above 29 kg/m².

Visceral obesity characterized by excessive fat in abdomen and assessed by waist to hip ratio appears to be a greater risk of CAD. Obesity promotes insulin resistance, hyperinsulinemia, hypertension, hyperlipoproteinemias and left ventricular hypertrophy. A waist to hip ratio less than 0.9 in men and less than 0.8 in women is desirable. This must be achieved both by caloric restriction and increased physical activity. Weight reduction with pharmacological agents is not recommended.

h) Other Measures :

1) Aspirin :

Low dose aspirin (75 -150 mg per day) has been shown to be effective in secondary prevention of CAD and in primary prevention in persons who are at high risk and without contraindication to its use.

2) Antioxidants :

Primary and secondary prevention of ischaemic heart disease has been attempted by the use of anti oxidants such as vitamin E, Vitamin C and beta carotene. There is no conclusive proof of the effectiveness of any of these agents.

3) Beta adrenergic blocking drugs :

Beta-drenergic blocking drugs are important elements in the secondary prevention and in reducing mortality in post myocardial infarction patients. They should be continued indefinitely if not contraindicated.

4) Hormonal Replacement Therapy :

Natural estrogens replacement should be considered in post menopausal women because they reduce the LDL and total cholesterol. However, prescribing them should

be individualized and considered in association with other health risks e.g. risk of breast cancer.

5) Angiotensin Converting Enzyme Inhibitors

(ACEI) :

These agents when introduced early after acute MI can prevent progressive LV dilatation, LV failure and cardiac mortality.

6) Oral Anticoagulants :

Warfarin is given to prevent pulmonary and systemic embolism in patients with deep vein thrombosis, cardiac thrombi and atrial fibrillation.

Chapter 14 : Ethical and Medicolegal

Aspects

C-14.1 : Fundamental Ethical Guidelines

- 1) Respected Patient Autonomy
- 2) Acting in the Best Interest of

Patients

- 3) Maintaining Confidentiality
- 4) Allocating Resources Justly
- 5) Avoiding Conflicts of Interest
- 6) Care of Dying Patients
- 7) Assisted Suicide & Active

Euthanasia

C-14.2 : Medicolegal Responsibility of the Physician

- 1) Diagnostic Errors
- 2) Informed Consent
- 3) Withdrawing & Withholding Treatment
- 4) Documentation
- 5) Complications
- 6) Drug-Related Events
- 7) Abandonment

In their practice, physicians apply skills, knowledge and experience to the prevention, detection and treatment of cardiovascular disease. They set high personal standards for their performance guided by a plethora of ethical principles that are often protected by law.

ETHICAL ISSUES

Cardiologist should be well informed about the common ethical dilemmas in clinical practice. Some of these are perplexing and emotionally draining.

Experience, common sense and good intention do not guarantee that ethical dilemmas can be identified and / or resolved.

C- 14.1 : Fundamental Ethical Guidelines

1. Respecting Patient Autonomy :

Physicians are required to obtain the patients consent to care after providing pertinent comprehensible information about the value of the proposed care and the alternatives. Occasionally, physicians may consider withholding a serious diagnosis or limiting discussion of prognosis or risks because they fear that the patient develops severe anxiety. This is unethical and should not be performed.

2. Acting in the Best Interest of Patients :

Physicians should take actions for patients benefit, not just avoiding harming them. A conflict might arise between beneficence and autonomy, e.g., a patient with suspected left main or 3 vessel coronary artery disease who refuses coronary arteriography. The physician should approach such conflicts by evaluating the patients' ability to make medical decisions and by providing adequate sound medical information. If the patient lacks decision-making capacity, the physician should look for the help of close relatives.

3. Maintaining Confidentiality :

Physicians need to guard against breaching of confidentiality. However, this is not an absolute rule, the law may require physicians to override confidentiality to protect other parties and physicians must report patients with noticeable diseases to public health authorities.

4. Allocating Resources Justly :

In some circumstances, two patients may compete for the same limited resources, e.g., a bed in intensive care. When this occurs, physician should ration resources according to patients' medical needs and the probability of benefit.

5. Avoiding Conflicts of Interest :

Physicians may try to withhold beneficial care to control cost or provide more care for financial incentives. These should be avoided. The physician should recommend available care that is in the patients' best interest, no more and no less.

6. Care of Dying Patients :

Spending time with dying patients, listening to them and paying attention to their psychological distress can ease their suffering.

7. Assisted Suicide and Active Euthanasia :

These are forbidden in Islamic and many other religious traditions as well as the Hippocratic Oath and the Egyptian law.

C-14.3 : Medicolegal Responsibility of the Physician

Negligence is considered as failure to exercise the degree of care ordinarily exercised by a "reasonably careful person" under the same or similar circumstances.

The physician is required to exercise the average degree of care, skill ordinarily exercised by members of the same profession under similar circumstances.

The cardiologists' primary exposure to malpractice liability arises from diagnostic errors. Other important issues include informed consent, withdrawal and withholding treatment, documentation, complications, drug related events and patient abandonment.

1. Diagnostic Errors :

Failure to diagnose acute myocardial infarction in the emergency department or outpatient clinic is one of the most common allegations in cardiology malpractice cases. A negative careful, well documented history, physical examination and 12-lead electrocardiogram interpretation can provide a powerful justification for decision not to admit even if that decision is shown in retrospect to be wrong. The medical observations obtained by others including nurses should be considered by the treating physician.

2. Informed Consent :

Because most patients lack the medical knowledge needed to make meaningful choices, health care providers have the duty of providing sufficient information to allow the patient to decide whether to undergo the proposed procedure.

It should include the patient's diagnosis, nature and a description of the recommended procedure, its expected benefit, any available alternatives and potential risk of the alternatives.

Exceptions to informed consent requirements include emergencies and incompetent patients. In the latter situation, consent must be obtained from an authorized relative.

3. Withdrawing and Withholding Treatment :

In some countries a competent patient has a legal right to refuse any form of medical intervention including life saving treatment such as a blood transfusion, mechanical ventilation and cardiopulmonary resuscitation. An incompetent patient has the same right to refuse treatment through his legal surrogate.

4. Documentation :

Health care providers who enter information in a patients' chart should always be alert to the fact that they are creating a legal document that could one day end up in court.

A proper medical record should chronologically, legally and understandably document the patient's medical history, physical examination, laboratory and other diagnostic testing and their results, differential diagnosis and the ultimate diagnosis including an explanation of how it was arrived at and the other diagnoses excluded.

In addition, it should include all informed consents, important conversations with the patient and his family, as well as the patient's refusals and non compliance.

Finally, the physician's treatment and instructions should be recorded. Once made, entries should be not modified. If additional information needs to be recorded, a separately dated, timed and signed entry should be made.

5. Complications :

Medical mal-occurrence and medical malpractice are not synonyms. The law recognizes that certain risks are inherent in all medical procedures. Cardiac catheterization for example, carry risks of bleeding, infection, vascular complications, anaphylactoid reactions and dysrhythmias. The mere occurrence of a complication that is a recognized risk of the procedure does not establish negligence and does not automatically create liability of the treating physician. Medical negligence or deviation from the acceptable standard of care has to be proven first usually by an expert testimony before malpractice is accepted.

6. Drug Related Events :

Medication orders must be legible, complete and unambiguous, leaving no room for misinterpretation by pharmacists and nurses. Polypharmacy encourages drug interaction that should be avoided if possible. If a decision is made not to use an important therapy, the reasons for this should be clearly documented in the patient's medical record.

7. Abandonment :

Claims of patient abandonment can arise when a physician unilaterally and unjustifiably terminates the doctor-patient relationships without the consent or knowledge of a patient. In addition, failure to provide competent coverage during periods of physician unavailability also constitutes abandonment. By contrast a physician may cease medical treatment based upon a decision that medical treatment is no longer required.

In Egypt, physicians malpractice liability is likely to be increasingly prevalent. Poor physician-patient support, low availability of practitioners and lack of adequate information provided and perceived are likely to be major risk factors that need to be tactfully

addressed by both individual physicians and various medical organizations.

Chapter 15 : Resuscitation and ICU Care

C-15.1 : Basic Life Support

C-15.2 : Advanced Cardiac Life Support (ACLS)

I) Team Leadership

II) General Considerations

1. Arrhythmia Recognition & Defibrillation
2. Airway Management & Oxygen Therapy
3. Route of Drug Administration
4. IV Fluids

III) Commonly Used Drugs

- a) Epinephrine
- b) Atropine Sulfate
- c) Lidocaine
- d) Procainamide Hydrochloride
- e) Bretylium Tosylate
- f) Sodium Bicarbonate
- g) Calcium

Cardiopulmonary arrest may be encountered in the patient with coronary artery disease (CAD) at variable situations. It may occur out of hospital as the first manifestation of CAD, after a brief episode of chest discomfort, palpitation or shortness of breath, or with a long previous history of CAD.

CPR Consists of :

Basic Life Support (BLS)

Advanced Cardiac Life Support (ACLS)

Post Resuscitation Care

C-15.1 : Basic Life Support (BLS)

The ABCs of basic life support (BLS) are Airway, Breathing, and Circulation. The goal of BLS is to provide oxygen to the brain and heart until definitive treatment (i.e., Advanced Cardiac Life Support, ACLS), can be delivered. Without proper BLS, ACLS is futile. When one encounters an unconscious patient in or out of hospital, the following procedures are recommended :

- Determine responsiveness by calling and gently shaking the patient. Get help, (e.g., medical or police attention), if possible.
- Position the patient on a firm flat surface. If spine injury is suspected, move the patient enmass. Open the patient's mouth, leaving dentures in place.

- To open airway, the head tilt-chin lift is the maneuver of choice. Place the palm of one hand on the patient's forehead and apply firm pressure to tilt the head backward. At the same time, place the index and middle fingers of your other hand under the patient's chin and displace the mandible anteriorly. If neck trauma is suspected, use the jaw thrust maneuver by grasping the angles of the patient's mandible with the fingers of both hands, one on each side and moving the mandible anteriorly.
- Assess for the presence of respiration with the airway open. Place your ear above the patient's mouth to listen and feel for airflow while observing for chest movement. If spontaneous respiration is not present, gently pinch the patient's nose closed with the index finger and thumb or the hand that is on the forehead. Make a tight seal over the patient's mouth and give two slow breaths (1.5-2.0 seconds each), followed by 10-12 breaths/minute. Avoid rapid and high-pressure breaths to avoid gastric distention. Take a breath after each ventilation. Each ventilation should be performed with sufficient volume to make the patient's chest rise, followed by a 2-second pause. Indicators of adequate ventilation are :

1. The rise and fall of the chest; and
2. Detection of escaping air during the patient's exhalation.

- Improper chin or head position is the most common cause of difficult ventilation. If the patient cannot be ventilated, reposition the head and attempt ventilation again. If ventilation is still unsuccessful, use obstructed airway maneuvers (see later).
- Palpate the patient's carotid pulse for at least 5 seconds. If a carotid pulse is present, continue rescue breathing at a rate of 10-12 slow breaths/minute.
- In the absence of a carotid pulse, initiate chest compression. Perform chest compression by placing the heel of one hand on the back of the other positioned 3cm above the patient's xiphoid process, with your shoulders directly above your hands and your elbows fully extended. Compress the patient's sternum 4-5 cm., thrusting straight down toward the spine. Compression should be smooth and regular, with an equal amount of time allowed for compression and release. Pressure must be completely released from the patient's chest after each compression, but your hands should remain in contact with the chest to maintain proper hand position. The recommended compression rate is 80-100 / minute. Assess the

adequacy of compression by periodically palpating the carotid pulse only in two-rescuer BLS. If only one rescuer is present, the chest compression : ventilation ratio should be 15:2. If two rescuers are available, the compression-ventilation ratio is 5:1, with a 2 seconds pause for ventilation after every 5 compression's. Once the patient is intubated, ventilation can be given at a rate of 12-15/minute, without pausing for compression.

- Stop BLS for 5 seconds at the end of the first minute, and every 2-3 minutes thereafter, to determine whether the patient has resumed spontaneous breathing or circulation. If a spontaneous pulse has returned, continue ventilation as needed. BLS should otherwise not be withheld for more than 5 seconds, except to intubate or defibrillate the patient. Attempts at intubation should not take more than 30 seconds before resuming CPR.

If an unconscious patient cannot be ventilated after two attempts at positioning the head and chin, perform abdominal thrusts. In the supine position, straddle the patient's thighs and place the heel or one hand against the patient's abdomen slightly above the umbilicus and well below the tip at the xiphoid. Place the second hand directly on top of the first. Then press posteriorly and cephalad with 6-10 quick upward thrusts. Follow this maneuver by sweeping debris from the patient's mouth with your finger, and repeat attempts at ventilation. When removing debris from the mouth, grasp the tongue and lower jaw as a unit with the thumb and fingers of one hand and lift them anteriorly and caudad. Place the index finger of the opposite hand down along the inside of the person's cheek deeply into the throat to the base of the tongue. Then use a hooking action to dislodge a foreign body and move it into the mouth where it can be grasped and removed. If attempts are unsuccessful in relieving the obstruction, repeat this sequence. Cricothyrotomy and transtracheal ventilation are rarely necessary.

C-15.2 : Advanced Cardiac Life Support (ACLS)

I. Team Leadership is essential to optimize patient survival.

II. General Considerations :

a) Arrhythmia Recognition and Defibrillation should be performed as quickly as possible. Monitoring paddles on defibrillators can be used to avoid delay of ECG monitoring. It is critical that the presence of palpable pulse, obtainable blood pressure, and the patient's level

of consciousness be considered in the overall treatment plan.

2. If pulseless ventricular tachycardia (VT) or ventricular fibrillation (VF) is present, perform defibrillation immediately. Patients with an automatic implantable cardioverter/defibrillator (AICD) or a pacemaker can be externally defibrillated without damage to the device, provided a defibrillation paddle is not placed over the device. Higher energy levels (> 200 joules) and anterior-posterior paddle positions may be necessary for defibrillation in patients with an AICD or a pace maker.
3. If a "flat line" appears on the monitor, the differential diagnosis includes loose leads, a lack of connection between the patient and monitor, isoelectrical VF masquerading as asystole, or true asystole. Operator mistakes are the most frequent cause of false asystole. Determining the rhythm in two or more leads should clarify the underlying rhythm.
4. Blind defibrillation in the absence of a rhythm diagnosis is rarely necessary because of the monitoring capabilities on most modern defibrillators. It should be considered only when monitoring is unavailable.
5. Proper technique is essential to the success of defibrillation. Place one paddle along the upper right sternal border below the clavicle and the other lateral to the nipple centered in the mid-axillary line. Use conductive gel or pads if available and apply firm paddle pressure to reduce transthoracic resistance. Individuals using the paddles must ensure that no one is touching the bed or the patient during a defibrillation.

b) Airway Management and Oxygen Therapy

are essential to any resuscitative effort. Oxygen (100%) should be administered, and endotracheal intubation should be accomplished by a qualified individual as soon as possible. Endotracheal tube position must be assessed immediately after placement. Equal bilateral breath sounds during ventilation should be present to ensure that a main stem bronchus has not been intubated. Auscultation over the stomach should be performed to exclude accidental esophageal intubation. BLS should not be interrupted for more than 30 seconds for intubation. Ventilation with a well-fitting pocket mask and

protection of the airway by suctioning is preferable to making repeated unsuccessful attempts at intubation.

Because of difficulty in maintaining a seal, a bag-valve device with a mask (e.g., AMBU bag), should only be used by experienced personnel.

c) Route of Drug Administration :

If an internal jugular or subclavian central venous line is in place before the arrest, it should be used for drug administration. If central access is not available, an antecubital vein should be cannulated so that BLS is not interrupted. The femoral venous route is not adequate. All injections must be flushed. If there is a delay in gaining venous access epinephrine, atropine, and lidocaine may be diluted in 10 ml saline and injected into the endotracheal tube and distributed into the bronchi by several forceful lung inflation's. The dosage for drugs used in this manner should be 2.0-2.5 times the recommended IV dose. If circulation is not rapidly restored after initial drug administration via a peripheral IV line, a subclavian or internal jugular IV line should be placed with minimal interruption of BLS. Intracardiac injections are not recommended.

d) IV Fluids :

IV fluids for volume expansion are indicated in patients with cardiac arrest and evidence of acute blood loss, hypovolemia or hypotension. Patients with acute myocardial infarction (MI), especially right ventricular infarction may also benefit from volume expansion with normal saline. Routine IV fluid administration in patients with cardiac arrest and no evidence of volume depletion is not recommended because it may diminish blood flow to the cerebral and coronary circulations.

III. Commonly Used Drugs :

a) Epinephrine :

Produces beneficial effects during CPR by increasing myocardial and cerebral blood flow. It is presently the catecholamine of choice for resuscitative efforts. The recommended dose is 1 mg (10 ml of a 1 : 10,000 solution) repeated at 3-to 5-minute intervals. High-dose epinephrine (5.0 mg or 0.1 mg/kg) should only be considered after the standard dose has failed. Epinephrine is well absorbed via the endotracheal route.

b) Atropine Sulfate :

Is the treatment of choice for symptomatic bradycardia, atrioventricular (AV) block at the nodal level, ventricular asystole and pulseless electrical activity (PEA). The recommended dose is 1.0 mg IV, repeated every 3-5 minutes if necessary, to a total dose of 0.4 mg/kg. For asystole or PEA, the dose is 1 mg repeated every 3-5

minutes. Atropine is well absorbed via the endotracheal route.

c) Lidocaine :

Is the antiarrhythmic of choice for treatment of VT or VF that persists following defibrillation and administration of epinephrine. It is also beneficial in stable VT and wide-complex tachycardias of uncertain type. An initial bolus of 1.0-1.5 mg/kg is required to rapidly achieve therapeutic levels. Additional boluses of 0.5-1.0 mg/kg can be administered every 5-10 minutes as needed to a total of 3 mg/kg. Only bolus dosing should be used in cardiac arrest. With the return of perfusion, a maintenance infusion of 2-4 mg/minute is recommended. Toxicity is more likely with decreased cardiac output, a patient older than 70 years and hepatic dysfunction. In these situations, the bolus dose remains unchanged but the maintenance infusion should be decreased by one-half.

d) Procainamide Hydrochloride :

Is recommended for the treatment of patients with recurrent VT when lidocaine is contraindicated or has failed. It is administered by infusion of 20-30 mg/minute until the arrhythmia is suppressed, hypotension ensues, the QRS is widened by 50% or a total dose of 17 mg/kg is reached. The maintenance infusion rate is 1-4 mg/minute. This drug should be avoided in patients with preexisting QT prolongation or torsades de pointes. Hypotension may occur if the drug is injected too rapidly.

e) Bretylium Tosylate :

Is used for treatment of refractory VT and VF when defibrillation, epinephrine, and lidocaine have failed. The dosage is 5 mg/kg given as an IV bolus. If cardiac arrest persists, the dosage is increased to 10 mg/kg and repeated every 5 minutes to a total dosage of 30-35 mg/kg.

f) Sodium Bicarbonate :

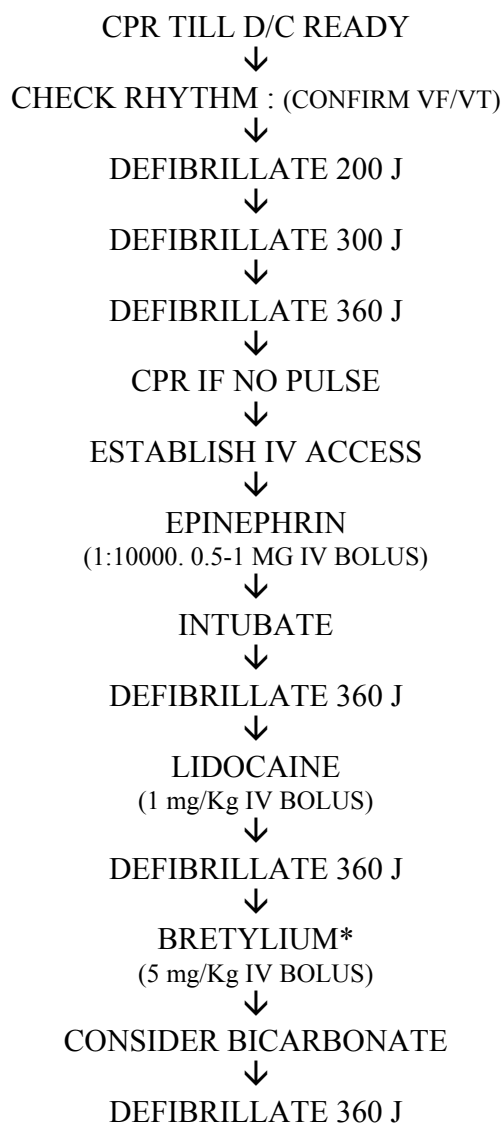
Is not recommended for routine use during the resuscitative effort. Its use should be based on a clearly defined diagnosis. Bicarbonate administration is indicated for hyperkalemia, preexisting acidosis, overdose with tricyclic antidepressants, and to alkalinize the urine in patients with drug overdose. The initial dosage is 1.0 m Eq/Kg given IV followed by 0.5 m Eq/Kg given every 10 minutes. In most patients with cardiac arrest, acidosis is uncommon if BLS is adequately performed. When acidosis is present it is usually due to inadequate ventilation and treatment should be directed to increasing minute ventilation. In absence of facility for arterial blood gas estimation, bicarbonate may be given empirically for prolonged CPR.

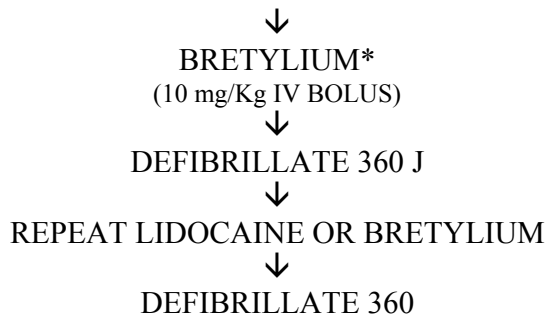
g) Calcium :

Calcium has not been shown to improve survival in patients with cardiac arrest. Its use should be limited to situations in which definite indications exist, including hyperkalemia, hypocalcemia, calcium channel blocker toxicity and electro-mechanical dissociation. When indicated, 10% calcium chloride is the preferred preparation and is given as an IV bolus of 5-10 ml (500-1000 mg); caution should be used in patients taking digitalis, because its toxic effects may be potentiated by calcium administration.

ALGORITHMS FOR BLS & ACLS WITH DIFFERENT SITUATIONS

VF & PULSESLESS VT





SUSTAINED VT

STABLE

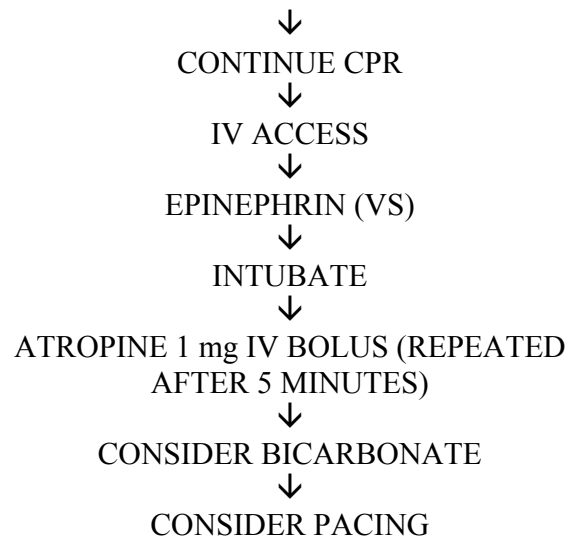
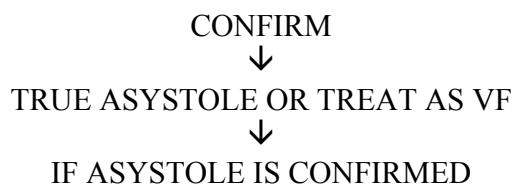
UNSTABLE

- O₂
- IV ACCESS
- LIDOCAINE (1 mg/Kg)
- LIDOCAINE (0.5 mg/Kg)
- Q 8 MINUTE TO VT END
- OR 3 mg/Kg)
- PROCAINAMIDE
(20 mg/MINUTE TO VT END)
- CARDIOVERT AS
- UNSTABLE PATIENT

- O₂
- IV ACCESS
- CARDIOVERT 50 J
- CARDIOVERT 100 J
- CARDIOVERT 200 J
- CARDIOVERT 360 J
- ADD PROCAINAMIDE
OR BRETYLIUM*
- CARDIOVERT AS ABOVE

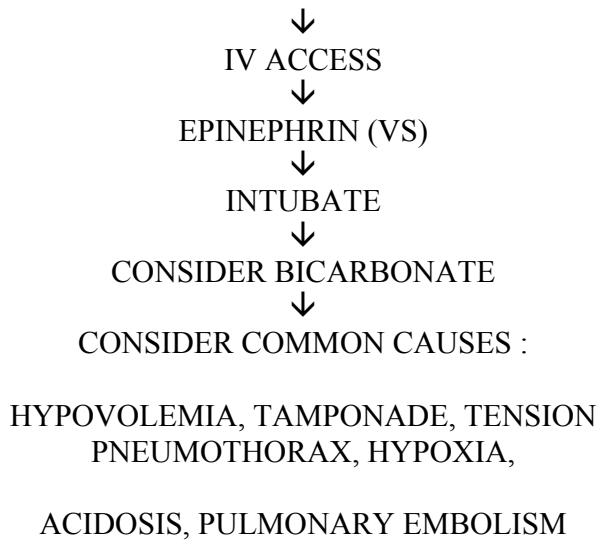
* If bretylium is unavailable, it may be replaced by either *amiodarone* (150-300 mg) IV bolus over 10 minutes, followed by an infusion of 1-2 mg/minute for 6 hours; or *Propranolol* (1 mg IV bolus repeated if necessary every 5 minutes to a total dose of 0.1 mg/Kg).

ASYSTOLE



***ELECTROMECHANICAL
DISSOCIATION***

CONTINUE CPR



Section D : RECOMMENDATIONS

1. EMERGENCY MEDICAL SERVICES

- Large cities are crowded with jammed traffic. The time factor is crucial in heart attacks. Ambulances are often poorly equipped. Ambulance personnel are poorly trained.
- A central single telephone number for urgent medical assistance has to be announced to the public. This number should lead to a physician who either directs an ambulance to the caller or directs the caller to go to the nearest hospital.
- Decentralization of ambulances is needed. At least one ambulance in every district should be equipped with a defibrillator, Oxygen therapy facility and IV fluid administration facility.
- Ambulance staff should include a doctor and a driver, both of whom should be thoroughly trained in Cardio-Pulmonary Resuscitation.
- An expert committee should periodically examine the ambulance service to check the availability, readiness and performance.

2. THE CORONARY CARE UNIT

The set-up for the management of definite or suspected acute coronary syndromes is best obtained in the coronary care unit (CCU). The essential features and basic requirements of the CCU are summarized below. Site : CCUs should be close to the emergency department [ED] of the hospital for the physician in

charge to move rapidly to ED if needed. It should be close to the laboratory and preferably to the surgical theater or case the help of an anesthesiologist is needed. Separate compartments or rooms are preferred to wards for patient privacy and infection control. CCU beds should constitute about 5% of general hospital beds. The area allocated should not be less than 15m² per bed.

PERSONNEL :

Physicians :

Should have completed at least two years of training in internal medicine and cardiology or anesthesia in a good standard teaching hospital with a high flow of critically ill patients. They should be thoroughly trained in Basic Life Support and Advanced Cardiac Life Support. They should be experienced in the basic maneuvers of venous and arterial access, endotracheal intubation and defibrillation. They should be familiar with the diagnosis of cardiac arrhythmia and blood gas abnormalities. They should also be familiar with the basic parameters of ventilator therapy. They should follow standard management guidelines selected by the hospital. Full time jobs are generally preferred to part time shift covers by many physicians from multiple institutes, to cultivate a sense of responsibility, care continuation and minimize disparity of treatment lines. The ratio of doctors to patients should be 1:2.

Nursing Staff :

In addition to standard basic nursing skills, a CCU nurse should be able to:

5. Efficiently perform single and double rescuer BLS.
6. Identify and immediately report respiratory distress, pain, hypotension, diminished sensorium and rhythm changes.
7. Identify VT, VF, SVT and bradycardia.
8. Administer emergency DC shock to VF or pulseless VT.
9. Communicate clearly with relatives and physicians.
10. Document in clear writing all findings, interventions and telephonic instructions by doctors giving names and exact times. The ratio of nurses to patients should be 3:1.

EQUIPMENT :

Equipping a coronary care unit needs good knowledge of :
 a) The facilities available on the hospital premises (space, electric power supply, central oxygen and suction, doors and corridors, space relations to the emer-

gency room, operating theater, laboratory and radiology departments and fire hazard facilities.

- b) The expected load of work.
- c) The expertise and preferences of the staff.
- d) A lot of previous experience in equipping CCUs.

Essential facilities include:

1. Oxygen outlets : With operational valves, flow meters, humidifiers, junctions, face masks and nasal prongs. A central oxygen network is preferred to changeable bed-side oxygen cylinders, which are cumbersome to replace and may fall and cause trauma. All places using oxygen should be equipped against fire hazards.
2. Monitors : Large screen non-fading displays with audible alarm are essential. Monitors should preferably be connected to a central display unit (central station) with freeze and write-out capabilities. Display of blood pressure, pulse oxymetry, respiration and intracardiac pressures are not essential requirements. Only two monitors need to be equipped with these capabilities.

3. A Mobile Defibrillator : With ECG-sensing paddles, large screen, auto-write-out and preferably transcutaneous pacing capabilities. CCUs with >10 bed should preferably possess 2 defibrillators. This machine should be constantly plugged in as it works on a rechargeable battery. Electrode gel should be kept close to it.
4. A resuscitation tray (crash cart) must be always present. It should contain :
 - a) Different sizes of laryngoscopes, airways, endotracheal tubes and junctions.
 - b) A bag-valve-mask unit (AMBU bag)
 - c) Electric suction machine (in absence of central bed-side suction) with different sizes of suction catheters.
 - d) Disposable canulae and electrodes (see below).
 - e) Essential medications (see below).



N.B. : BOTH THE CRASH CART AND DEFIBRILLATOR SHOULD NEVER BE REMOVED FROM THE CCU ON THE BASIS OF BEING NEEDED FOR OTHER HOSPITAL UNITS. THEY SHOULD BE CHECKED FOR COMPLETENESS AND TESTED FOR FUNCTIONALITY AT THE BEGINNING OF EACH SHIFT. THE RESULT OF TESTING SHOULD BE DOCUMENTED IN WRITING. FAILING TO DO SO CAN AND DOES COST PATIENTS' LIVES AND IS A MAJOR SOURCE OF MEDICO-LEGAL LIABILITY.

Essential consumables include:

5. Facility for emergency transvenous pacing, particularly if transcutaneous pacing is not available.
 6. A volume cycled ventilator with capabilities for nebulizer therapy and positive end-expiratory pressure (PEEP) ventilation. A ventilator is preferred in the CCU, but not essential if one is present in the general ICU or the hospital. A central oxygen network is essential for ventilator operation. CCUs with ventilators should have free and immediate access to blood gas analysis.
 7. Procedure room equipped with C-arm fluoroscopic X-ray unit, crash cart space for medications and consumable and facility for scrubbing.
1. Drugs : In addition to drugs mentioned under ACLS (items A - K), the CCU drug drawers should contain :
 - a) Opiate injections (morphine and pethedin) for pain relief
 - b) Streptokinase ampoules and one dose of tPA.
 - c) IV and SC heparin preparations,
 - d) Aspirin.
 - e) IV and oral short and long acting beta blockers.
 - f) IV SL and transcutaneous nitrate preparations.
 - g) Short and long acting angiotensin converting enzyme inhibitors.
 - h) Sodium nitroprusside ampoules.
 - i) Dopamine, Dobutamin and Noradrenaline ampoules.
 - j) Frusemide ampoules and tablets.
 - k) Hydrocortisone ampoules
 - l) Inhalation beta 2 agonist (e.g., salbutamol)
 - m) Anxiolytic agents (e.g., diazepam) oral and IV preparations

CONSUMABLES

- n) Bulk or lubricant laxative (lactose, dicytyle sodium sulfosuccinate or parafin oil)
 - o) Basic antibiotics for respiratory and skin cannula infection (amoxcilin, trimethoprin sulfa, erythromycin, flucloxacililin, gentamycin and crystalline penicillin). Other antibiotics may be obtained from the general hospital pharmacy.
 - p) Soluble rapid-acting insulin.
 - q) KCL ampoules.
 - r) Panthenol ointment for defibrillator burns.
1. The quantity needed for each drug is determined from the work load, staff preferences and past experience.
2. Venous Access and Infusion : Short and long canulae, CVP catheters, infusion sets, micro-drippers & butterfly canulae. Different sizes should be available. Fluids for infusion include normal saline, 5% and 10% dextrose (as well as 50% dextrose arnpoules for hypoglycemia), Ringer and lactated ringer solutions, Dextran, Sodium bicarbonate, glucose saline and hypertonic saline solutions.
 3. **Oxygen Therapy** : Face masks and nasal prongs.
 4. Suction Catheters: Thin sterile endotracheal and large oral suction catheters should be available.
 5. Entubation : Different sizes and lengths of cuffed endotracheal tubes for oral or nasal insertion, airways, connectors and adapters.
 6. Urinary Catheters : Self-retaining urinary catheters and collection bags.
 7. ECG Electrodes : Silver-silver chloride electrodes are preferred.
 7. Discharge or referral summary (should include personal data, physician in charge, admission and discharge diagnosis, status at discharge, and recommended treatment).
 8. Major complications report should detail major events such as serious complications of procedures and drugs, giving details of dates, personnel involved, justification of the intervention, measures taken and final outcome.

3. NON-INVASIVE TESTING

Exercise laboratories should be inspected and licensed. The laboratory staff should include a qualified physician plus a trained nurse or an assistant physician. All laboratory staff should be trained and tested for BLS/ACLS. All labs should include a defibrillator, equipped crash cart and oxygen facility (refer to sections on CCU & CPR).

4. DIAGNOSTIC AND INTERVENTIONAL CARDIAC CATHETER

Site : The lab should be located in a hospital with a cardiology service including more than one qualified invasive cardiologist and a CCU. Interventional procedures should only be performed in a hospital with equipped and functional open heart surgery and with surgical back-up.

Personnel : The team leader should have a minimum experience of 300 diagnostic and 50 interventional procedures and must be currently performing at least 3 diagnostic and 2 interventional cases weekly. Trainees should complete a minimum of 200 diagnostic cases before starting to perform interventional catheter. They should do at least 50 cases as assistant and 30 as a supervised primary operator before being allowed to work on their own. The lab also should have a radiology technician with catheter laboratory experience of at least 50 cases, a scrub nurse and an assistant nurse. All laboratory staff should be trained and tested for BLS/ACLS. All labs should include a defibrillator, equipped crash cart and oxygen facility (refer to sections on CCU & CPR)

MEDICAL RECORDS :

The following constitutes the essential record-keeping of the CCU patient :

1. Admission sheet
2. Daily progress notes
3. Daily medication sheet
4. Daily observation sheet (includes vital signs, fluid intake and output)
5. Medication follow-up tables such as PT or PTT for anticoagulation, blood or urine sugar for antidiabetic therapy.
6. Daily nurses notes.

5. REHABILITATION

A scientifically planned rehabilitation program is lacking in most centers. An integral part of patient care is the development of this program. Two important adjuncts to this program are :

- a. Dietitian services should be recruited and included in the care of patients

with diabetes, dyslipidemia and obesity.

- b. A smoking cessation program should be established.

6. PHYSICIAN EDUCATION

• Medical School Curriculum

- **Knowledge** : By the end of six years

(graduation) the student should :

- a) Know the mechanism of lipid, carbohydrate and protein metabolism, the needed caloric requirement for each age group and the balanced distribution of food to keep ideal body weight.
 - b) Explain the pathophysiology and its molecular basis of atherosclerosis and factors enhancing its progression.
 - c) Define physical fitness and demonstrate the impact of regular exercise on health and disease.
 - d) Draw and explain the Anatomy and physiology of coronary circulation.
 - e) Demonstrate cardiac cycle and conductive system of the heart.
 - f) Enumerate risk factors for coronary artery disease and their relative weights.
 - g) Identify the different clinical presentations of CAD.
 - h) Outline the indications of different diagnostic procedures and interpret the commonly used ones, e.g., ECG, Echo.
 - i) Explain treatment of stable Angina, unstable Angina and Myocardial infarction.
1. h) Be able to conduct health education program for primary and secondary prevention.
 2. Skills : Students should acquire the skills of :
 - g) Comprehensive clinical examination.
 - h) CPR.
 - i) Performing venous access.
 - j) Self directed learning.
 - k) Use of computer.

- **Attitudes** : Students should :

- a) Be able to work in a team as member and leader.
- b) Be able for early recognition of emergency and prompt action.
- c) Able to conduct health education program for primary and secondary prevention, promotion of health of the community.

• Post Graduate Training and Family Physician

Program :

Master the skills of clinical evaluation of a cardiac patient.

Acquire the skill of ECG interpretation.

Outline indications, limitations and contraindications of different forms of stress testing.

Interpretation of Echocardiography.

When to refer for nuclear imaging and Coronary Angiography.

Adoption of a system for Follow-Up, cardiac rehabilitation and Prevention.

Awareness of Ethical Issues, Medicolegal Aspects and Quality Assurance of Medical Practice.

Emphasis on continuing medical education and self-directed learning.

Consideration of Cost-Benefit and Benefit-Risk Ratio.

• Core - Elements

- CPR & ACLS :

Physician dealing with cardiac emergencies must have proper and standard training for CPR and ACLS and periodically certified.

- ECG Reading and Arrhythmias :

- a) Proper training of ECG reading and recognition of different formats of ischaemic pattern using different learning methods, e.g., workshops, seminars, quiz, etc.
- b) Arrhythmia recognition should be performed as early as possible.
- c) Proper management of different types of arrhythmia pharmacological or otherwise.

- Drugs in Cardiac Emergencies :

Physician should know indications, contraindications, dose, side effects, route of administration and drug interactions of the following :

Nitrates	Narcotics
Thrombolytics	
Anticoagulants	Antiplatelets
Beta Blockers	
Diuretics	Lidocaine
Atropine Sulfate	
Ca Gluconate	Na Bicarbonate

7. PUBLIC EDUCATION

- **Diet** : Public should be clearly informed about :

Importance of balanced diet and that excess fat intake is closely linked to the progression of atherosclerosis and consequently CAD and stroke.

Public should be advised to reduce saturated fat (animal fat) and use instead vegetable oils.
 Public should be encouraged to increase consumption of vegetables and fruits.
 Public should be advised to increase amounts of white meat and fish on the expense of red meat.
 Moderation of salt intake is advisable.

• **Life Style Modification**

- **Weight Reduction :**

- 1) Public should be encouraged to keep their ideal body weight as obesity has direct relation to hypertension, diabetes mellitus and hyperlipidaemia.
- 2) Mothers should be advised to keep their kids to the ideal weight.
- 3) Public should be informed that reduction of weight in obese persons has a beneficial effect on controlling risk factors.

- **Physical Activity :**

Public should be informed that regular exercise on the average of 3 times/week for 45 minutes has a beneficial effect on general health and at low cost.
 Regular aerobic exercise will keep ideal body weight, muscle mass, physical fitness and sense of well being.
 Dynamic exercise should be preferred to static exercise particularly in patients with hypertension and coronary artery disease.

- **Tobacco Use :**

Effective health education activities and campaigns against smoking should be implemented using different means : School, Mosques, Churches, TV, Radio, etc.
 Plan taking the necessary legislative action such as :
 Banning smoking in public places, schools, theaters and health care facilities.
 Banning of tobacco advertising and promotion.
 Banning vending machines and selling cigarettes to children.
 Banning new investment in the development of tobacco industry.
 Increase taxation on tobacco products.
 Appropriate warning labels.
 Helping smokers to quit smoking by offering different means : Family and psychological support, nicotine chewing gums and patches.
 (These recommendations should be conducted to the government, health authorities and conveyed to the public through different means : Schools, Mosques, Churches, Clubs, Media, etc..)

• **Periodic Check-Up of Blood Pressure and Plasma Lipids :**

- a) Every individual above the age of 40 should have his blood pressure checked once every year.
- b) Those who have a family history of hypertension, should start checking their blood pressure earlier and at short intervals.
- c) Public should be informed that hypertension is common, and disease of no symptoms and there is nothing called nervous hypertension.
- d) Public should know once treatment started should be followed up indefinitely.
- e) Public should be clearly informed about the serious consequences of untreated hypertension such as CAD, CHF and renal failure.
- f) Individuals should check their plasma lipids yearly since the age of 40.
- g) Those who have family history of hyperlipidemia and CAD should check their serum lipids earlier at the age of 20.
- h) Hypertensive patients and those with hyperlipidaemia are strongly advised for life style modification.

Symptoms of Heart Attack :

- a) Those with any exertional chest pain should seek medical advice. Especially those with previous history of CAD.
- b) If developed significant chest pain, chew a tablet of aspirin until gets medical attendance.
- c) Public should be informed that if he develops severe chest pain more than 15 minutes, especially if associated with syncope, sweating or palpitation should be rushed to emergency cardiac care.
- d) Those who have history of CAD should use GTN while setting and can use it as frequently as needed.

8. BASIC LIFE SUPPORT - CPR

Public should be informed about :

Heart disease is a major health problem.
 Half of deaths due to CAD are sudden and out of hospital due to cardiac arrest.
 Many patients with cardiac disease can be saved.
 Some symptoms need early hospitalization.

The Groups to be Trained in CPR are :

- 1) Emergency Public Service Agencies :
 Ambulance staff
 Police
 Fire Squad
- 2) Other Public Active Groups :

Sport trainers

Scouts

General public volunteers

- 3) Organization of CPR training teams in major hospitals with training assignments in and out of hospitals.
- 4) Periodic training courses for highly targeted groups with certification.

Basic materials required for CPR training course :

Written and illustrated short statements.

Adult and pediatric training models for both closed compression and mouth-mouth breathing for training.

Projection slides.

Standard exams for testing.

Equipping ambulances, police and fire squads :

Portable automatic defibrillator - necessary drugs, ambo bag, O₂ cylinders.

Incentives for person's performance of CPR :

Give each person a presentable certificate.

Explain the relevance of their training in saving lives.

Make a successful course completions a pre-requisite for obtaining a suitable job in emergency public service.

9. RECOMMENDATIONS FOR FUTURE

RESEARCH

Research in CAD, whether epidemiological or clinical, should be encouraged and supported by many authorities and institutions. The Ministry of Public Health, Universities, Scientific Societies, Pharmaceutical companies and WHO can promote such research programs. Foreign sources for funding and donations may also contribute.

Such funding will allow addressing our community health problems as CAD - either through population and epidemiologic research or through clinical relevant studies.

Suggested studies are :

a) Population - Based :

Prevalence of coronary heart disease among Egyptians whether in rural, urban, coastal or Sahara areas; and to delineate the principle risk factors in our country, i.e., dyslipidemia, smoking, hypertension, diabetes, obesity, physical inactivity and socioeconomic factors.

Assessment of risk factors control on coronary artery disease patients considering changes in event rates, complications and impact on prognosis.

Evaluation of the different CCU settings in Egypt, their distribution, functioning capabilities, caliber of personnel and their performance.

Prevalence of coronary artery disease in women

includes also patterns of presentation, access to non-invasive and invasive procedures. Referral for angiography, PTCA or CABG will be compared to male patients.

Effect of hormonal replacement therapy in post-menopausal females value in reducing coronary artery disease incidence and event rate.

b) Clinical Studies :

- 1) Presentation, risk profile and complications of AMI in old age (> 65 years).
- 2) Gender and relation to in hospital short-term and long-term prognosis after PTCA, stenting and CABG.
- 3) Thrombolysis in AMI : Utilization and complications as related to gender.
- 4) B-mode ultrasound for carotid estimation and relation of changes intima-media thickness and carotid flow to coronary affection, a possible follow-up study in coronary artery disease patients.

SUMMARY

Coronary Artery Disease (CAD) is becoming an important cause of disability in Egyptians. According to the predictions of the World Health Organization (WHO), and World Bank, heart disease will be the main cause of disability world wide by the year 2020. Because of its increasing importance, the Egyptian Hypertension Society invited a group of Egyptian experts with extensive background in the management of coronary patients to write a short manual about CAD including national guidelines which cover areas of diagnosis, treatment and prevention. The main objective was to clarify the indications, limitations and whenever possible the cost effectiveness of the different diagnostic and therapeutic modalities and provide plans for practical management and prevention of coronary disease.

The guidelines stress the following points :

- A careful and detailed history is critical in the identification of the origin of chest pain and the diagnosis of angina pectoris.
- Exercise stress ECG should be part of the routine evaluation of coronary patients, however, physicians should be aware of the limitations of this important test.
- Echocardiography and nuclear imaging studies are needed when stress ECG is not informative. Echocardiography should be done in many patients with myocardial infarction (MI).
- Coronary angiography determines the presence, extent, severity and morphologic characteristics of CAD. Its main limitations besides being an invasive procedure, is the fact that it visualizes only the lumen of coronary arteries. Coronary artery lesions of greater than 50 % diameter

- stenosis are not necessarily associated with subsequent MI.
- There is no definite evidence to support the routine use of coronary angiography after MI. The addition of the results of angiography to the clinical and exercise data did not significantly improve the ability to predict subsequent mortality.
 - Risk stratification is a very important step in the evaluation of patients presenting with stable angina or acute coronary syndromes, i.e., unstable angina, non-Q wave MI and acute MI. Patients can be categorized into three groups : high, intermediate and low risk regarding the risks of development of sudden death and non-fatal myocardial infarction.
 - Coronary angiography and revascularization procedures are indicated in the high risk category.
 - Risk stratification is based on patients' overall cardiovascular risk profile, character of chest pain, presence of reversible ischemic ECG changes, extent of left ventricular dysfunction, electrical instability, previous MI, results of stress testing and perfusion imaging, response to therapy and associated carotid or peripheral atherosclerotic disease.
 - Beta-Blockers and aspirin, unless contraindicated, should be given to all patients with CAD.
 - Nitrates have no place in the long term management of asymptomatic coronary patients and have no beneficial effect on survival in this group. However, they should be administered in optimal dosage to relieve angina in symptomatic patients.
 - Patients with ischemic chest pain in the last 12 hours accompanied by greater than one mm ST segment elevation in two contiguous ECG leads (counting III and aVF as one lead) or LBBB should receive, unless contraindicated, thrombolytic therapy (e.g., streptokinase), regardless of age, gender, site and extent of infarction, level of blood pressure or other risk factors. This should be followed by I.V. or S.C. heparin for 3 days and aspirin indefinitely.
 - New antiplatelet agents, namely drugs that block platelets fibrinogen receptors - GP IIb/IIIa receptor blockers have a promising role in the management of coronary patients. They are given to some patients undergoing angioplasty and those with acute coronary syndromes.
 - ACE Inhibitors should be given to all patients with large myocardial infarction and/or those with impaired LV systolic function.
 - CAD is difficult to diagnose in women, since noninvasive studies are less reliable in females, exercise ECG has many false positive results. Risks of CAD disease are greatly increased in diabetic and post-menopausal women.
 - Results of coronary angioplasty and surgical bypass grafting are poorer in females than males. Hormonal replacement therapy by natural estrogens in post-menopausal women causes definite reduction in cardiac events.
 - All patients with suspected CAD, whether stable or unstable, should undergo blood testing for lipid profile. An increase in plasma low density lipoprotein (LDL)-cholesterol is a major risk factor for development of CAD, its importance can be improved by concomitant measurement of HDL-cholesterol levels.
 - Aggressive lowering of LDL-cholesterol of less than 100 mg/dl is recommended in coronary patients through a combination of dietary measures and lipid lowering therapy by statins.
 - Some of the statins proved effective in preventing death, recurrence of MI or acute coronary events and in reducing the need for revascularization in patients with CAD.
 - All individuals 40 years or older should have an annual measurement of their blood pressure and plasma lipids.
 - Government and non-government organizations should establish nationwide campaigns to stop cigarette smoking and encourage adoption of a healthy life style, i.e., correction of obesity, regular physical exercise, avoiding excess salt and animal fat in diet.
 - Members of medical community, police, fire squad, sportsmen should be trained in basic life support.

Table 1 : PROPERTIES OF VARIOUS β -ADRENOCEPTOR ANTAGONIST AGENTS, NONSELECTIVE AGENTS, CARDIOSELECTIVE AND VASODILATORY AGENTS

Generic Name (Trade Name)	ISA	Plasma Half-Life (hr)	Lipid Solubility	First-pass Effect	Loss by Liver or Kidney	Plasma Protein Binding (%)	Usual Dose for Angina	Usual Doses as Sole Therapy for Mild/Moderate Hypertension	IV Dose (Caution)
<i>Noncardioselective</i>									
Propranolol (Inderal)	-	1-6	+++	++	Liver	90	120-140 mg/day, 3-4 divided dose, 80 mg 2x daily. Usually adequate. Start as for hypertension	Start with 10-40 mg 2x daily to lessen side-effects. Mean 160-320 mg/day, usually 120 mg 2x daily.	1-10 mg (0.1 mg/Kg)
Timolol (Blocadren)	-	4-5	+	+	L, K	60	15-45 mg (in 3-4 divided doses)	20-60 mg/day = 160-480 mg/day propranolol, 2-3 dose/day	0.4-1 mg
Nadolol (Corgard)	-	16-24	0	0	Kidney	20	80-240 mg 1x daily; mean 110 mg	40-560 mg/day; mean 110 mg/day single dose	
Sotalol (Sotacor)	-	15-17	0	0	Kidney	5	160-480 mg/day single dose	80-320 mg/day; mean 190 mg	10-20 mg
<i>Cardioselective</i>									
Acebutolol (Sectral)	++	8-12 (diacetolol) metabolite	0 (diacetolol)	++	L,K	15	200-400 mg 2x daily; 900 mg optimal	400-1200 mg/day; can be given as a single dose	12.5-50 mg
Atenolol (Tenormin)	-	6-9	0	0	Kidney	10	100 mg 1x daily; 25 mg 2x daily	50-200 mg/day as single dose; usual dose 100 mg. Flat dose response curve	5-10 mg
Bisoprolol (Concor)	-	15	++	++	L, K	30	5-20 mg 1x daily	10-20 mg once daily	-
Metoprolol (Lopressor) (Betaloc)	-	3	+	++	Liver	15	50-100 mg 2 or 3x daily; mean total 200mg	50-400 mg/day; means about 250 mg in 1 or 2 doses	5-10 mg
<i>Vasodilatory β-Blockers, nonselective</i>									
Labetalol (Trandate) (Normodyne)	-	3-4	+++	++	Liver	90	As for hypertension	300-600 mg/day in 3 doses; top dose 2400 mg/day	1-2 mg/Kg for severe hypertension

ISA = Intrinsic Sympathetic Activity, L= liver; K= kidney; HT= hypertension; data sources, Frishman and Sonnenblick 82 and Physician's Back Reference (1990).

Table 2 : CALCIUM ANTAGONISTS : INDICATION AND DOSAGE

<i>AGENT</i>	<i>INDICATIONS</i>	<i>DOSE</i>
Verapamil (Isoptin)	Paroxysmal supraventricular tachycardia (SVT) with narrow QRS	IV bolus 5-10 mg repeated after 10 min, then 0.005 mg/kg/min if needed IV infusion 1 mg/min to total of 10 mg If myocardial disease. work up from 0.0001 mg/kg/min, titrating against heart rate
	Atrial flutter/fibrillation (control of ventricular rate)	IV infusion, if needed; or 80-120 mg 3x daily increase to 80-120 mg 4x daily; beware of digitalis toxicity.
	Prophylaxis of PSVT Angina of effort, unstable angina, Prinzmetal's angina Hypertension, mild to moderate Hypertrophic cardiomyopathy	Orally 240-480 mg daily in divided doses
Diltiazem (Cardizem) (Tildiem) (Delaytiazem)	Angina of effort, unstable angina, Prinzmetal's angina Non-Q-wave infarction Hypertension	Orally 30 - 90 mg 3x daily increasing 4 x daily as indicated.
Nifedipine (Procardia) (Adalat Retard) (Epilat)	Angina of effort Prinzmetal's angina Hypertension, mild to moderate	Orally 30 - 80 mg daily in 3 or 4 doses: Adalat retard 30-150 mg daily
Other Calcium Antagonists : Amlodipine (Norvasc) Lacidipine (Lacipil)		Oral 2.5 - 10 mg once / daily Oral 2 - 8 mg once / daily

PSVT = Paroxysmal Supraventricular Tachycardia
IV = Intravenous
LV = Left Ventricular

Table 3 : NITRATES

<i>COMPOUND</i>	<i>ROUTE</i>	<i>PREPARATION & DOSE</i>	<i>DURATION OF EFFECTS & COMMENTS</i>
Nitroglycerin (trinitrin, TNT, glyceryl trinitrate)	a) Sublingual	0.3 - 1.5 mg, as need Tablets-usually 0.3,0.5 or 0.6 mg	1 ½ min - 1 hr; peak blood levels at 2 min (1/2 - time of 7 ½ min)
	b) Spray	0.4 mg/metered dose as needed	Effects apparent within 1-2 hr, last 8-12 hr during intermittent therapy. Not effective during continuous therapy.
	c) Percutaneous	2 % ointment 15 x 15 cm or 12.5-40 mg	
	d) Transdermal patches: Nitrocine, Transederm-Nitro, Nitroderm,	7.5 - 10 mg/12hr or 16 mg/14 hr	
	e) Oral; sustained-release	3-12 mg/hr	
	f) Intravenous	0.1 mg bolus (care; lower dose for new sets) Tridil 0.5 mg/ml 20-200 mg/min	
Isosorbide dinitrate (=sorbide nitrate Isordil Isordil Tembids)	a) Sublingual	5-15 mg 5-80 mg 2-3 x daily (top dose 480 mg daily)	Onset 5 - 10 min, effect up to 60 min Exercise time raised for 2-8 hr (see text for tolerance)
	b) Oral	1.25 mg on tongue	Rapid action 2-3 min
	c) Spray	5 mg as single dose	Exercise time raised for 2 min
	d) Chewable	40 mg once or 2 x daily	May need increasing doses for unstable angina at rest
	e) Oral; sustained-release	1.25-5.0 mg/hr (car; absorbed into tubing)	Not effective during continuous therapy.
Isosorbide-5-ononitrate (not in USA)	f) Intravenous	100 mg/24 hr	Claimed efficacy up to 9 hr during chronic use, depending on preparation.
	g) Ointment	10-40 mg 2 x daily eccentric dosage	
	Oral Sustained-release	40 -100 mg 1 x daily	

