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# **Pharmacotherapy of Ischemic Heart Disease (IHD)**

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# Definition

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- Ischemic heart disease (IHD) is defined as
  - a lack of oxygen and decreased or no blood flow to the myocardium resulting from coronary artery narrowing or obstruction.
- IHD may present as
  - ACS
    - UA, STE-MI or STE-MI
  - chronic stable exertional angina
  - Variant angina

# Pathophysiology

- The major determinants of myocardial oxygen demand ( $MVo_2$ ) are
  - heart rate (HR)
  - contractility and
  - intramyocardial wall tension during systole
- Wall tension is thought to be the most important factor.
- Because the consequences of IHD usually result from increased demand in the face of a fixed oxygen supply,
  - alterations in  $MVo_2$  are important in producing ischemia and for interventions intended to alleviate it.

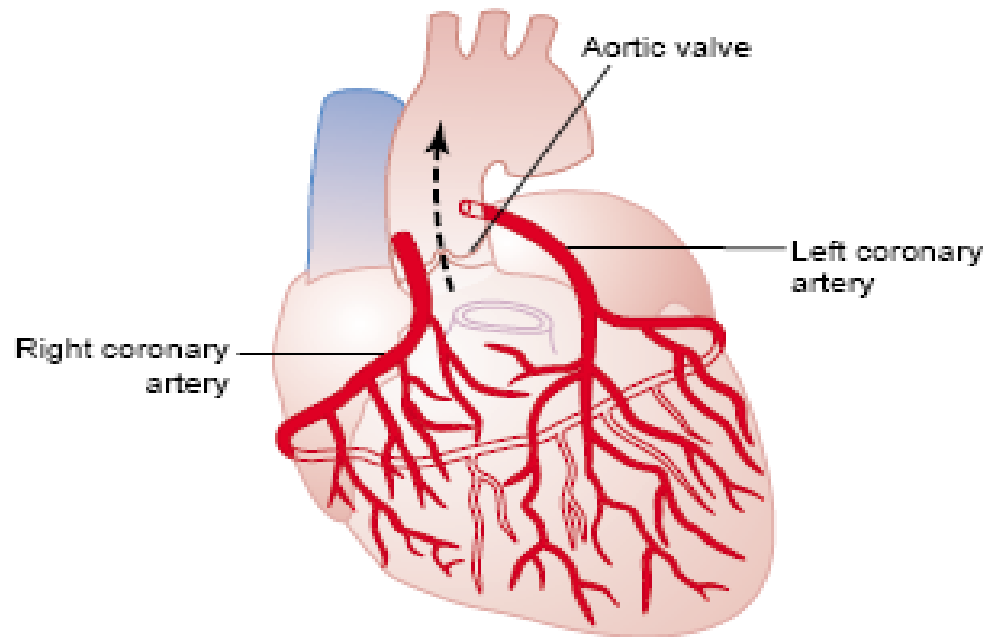


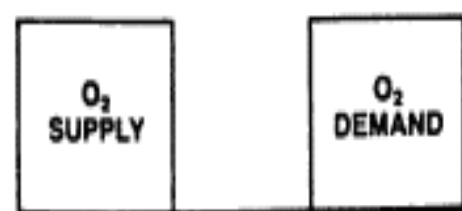
Figure 21-3

The coronary arteries.

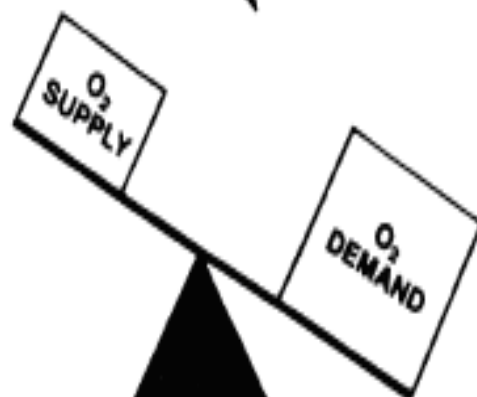
DURING REST  
Healthy Heart and Heart with CAD



DURING EXERTION



Healthy Heart



Heart with CAD

Fig. Effect of exertion on the balance between oxygen supply and oxygen demand in the healthy heart and the heart with coronary artery disease (CAD). In the *healthy* heart, O<sub>2</sub> supply and O<sub>2</sub> demand are always in balance; during exertion, coronary arteries dilate, producing an increase in blood flow to meet the increase in O<sub>2</sub> demand. In the heart with CAD, O<sub>2</sub> supply and demand are in balance only during rest. During exertion, dilation of coronary arteries cannot compensate for the increase in O<sub>2</sub> demand, and an imbalance results.

# Cont...

- A clinically useful indirect estimate of  $MVo_2$  is the double product (DP), which is HR multiplied by systolic blood pressure (SBP)
  - **$DP = HR \times SBP$**
  - The DP does not consider changes in contractility
- The **prime determinants** in the occurrence of ischemia.
  - The caliber of the resistance vessels delivering blood to the myocardium and
  - $MVo_2$

# Cont...

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- The normal coronary system consists of
  - large epicardial or surface vessels (**R1**)
    - offer little resistance to myocardial flow and
  - intramyocardial arteries and arterioles (**R2**)
    - branch into a dense capillary network to supply basal blood flow
- Under normal circumstances, the resistance in  $R2 \gg R1$
- Myocardial blood flow is
  - inversely related to arteriolar resistance and
  - directly related to the coronary driving pressure.

# Cont...

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- Atherosclerotic lesions occluding R1 increase arteriolar resistance, and R2 can **vasodilate** to maintain coronary blood flow.
- With greater degrees of obstruction, this response is inadequate, and the coronary flow reserve afforded by R2 vasodilation is **insufficient** to meet oxygen demand.
- Relatively severe stenosis ( $>70\%$ ) may provoke ischemia and symptoms at rest, whereas less severe stenosis may allow a reserve of coronary blood flow for exertion.



# Cont...

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- Persisting ischemia may promote growth of developed collateral blood flow.
- Lesions creating obstruction of 50% to 70% may reduce blood flow, but these obstructions are not consistent
  - vasospasm and thrombosis superimposed on a “noncritical” lesion may lead to clinical events such as MI.

# Cont...

- Abnormalities of ventricular contraction can occur, and regional loss of contractility may impose a burden on the remaining myocardial tissue, resulting in
  - HF, ↓ed MVO<sub>2</sub> and rapid depletion of blood flow reserve.
- Non-ischemic areas of myocardium may compensate for the severely ischemic and border zones of ischemia
  - by developing **more tension** than usual in an attempt to maintain cardiac output.

# Grading of Angina Pectoris by the Canadian Cardiovascular Society Classification System

Class	Description of Stage
Class I	Ordinary physical activity does not cause angina, such as walking, climbing stairs. Angina occurs with strenuous, rapid, or prolonged exertion at work or recreation.
Class II	Slight limitation of ordinary activity. Angina occurs on walking or climbing stairs rapidly, walking uphill, walking or stair climbing after meals, or in cold, or in wind, or under emotional stress, or only during the few hours after wakening. Walking more than 2 blocks on the level and climbing more than 1 flight of ordinary stairs at a normal pace and in normal condition.
Class III	Marked limitations of ordinary physical activity. Angina occurs on walking 1 to 2 blocks on the level and climbing 1 flight of stairs in normal conditions and at a normal pace.
Class IV	Inability to carry on any physical activity without discomfort—anginal symptoms may be present at rest.

# Clinical Presentation

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- Many episodes of ischemia **do not cause symptoms** of angina (silent ischemia), in at least 60% of patients
- Patients often have a reproducible pattern of pain or other symptoms that appear after a specific amount of exertion.
- Increased symptom frequency, severity, or duration, and symptoms at rest suggest an **unstable pattern** that requires immediate medical evaluation.

# Cont...

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- Symptoms may include a sensation of pressure or burning over the sternum or near it, which often radiates to the left jaw, shoulder, and arm.
- **Chest tightness** and **shortness** of breath may also occur.
  - The sensation usually lasts from 30 seconds to 30 minutes.
- **Precipitating factors** include
  - Exercise, cold environment, walking after a meal, emotional upset, fright, anger and coitus.
- **Relief** occurs with rest and within 45 seconds to 5 minutes of taking nitroglycerin

# Clinical Presentations

## General

- ❑ Many episodes of ischemia do not cause symptoms of angina (silent ischemia)
- ❑ Patients often have a reproducible pattern of pain or other symptoms which appear after specific amount of exertion
- ❑ Increased frequency, severity, duration, or symptoms at rest suggest an unstable angina pattern and the patient should seek help immediately

## Symptoms

- ❑ ② Sensation of pressure or burning over the sternum or near it, often but not always radiating to the left jaw, shoulder and arm; also chest tightness, shortness of breath
- ❑ Pain usually lasts from 0.5 to 30 minutes, often with a visceral quality (deep location)
- ❑ Precipitating factors include exercise, cold environment, walking after a meal, emotional upset, fright, anger, and coitus
- ❑ Relief occurs with rest and nitroglycerin

## Signs

- ❑ Abnormal precordial (over the heart) systolic bulge
- ❑ Abnormal heart sounds

# Diagnosis

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- Important aspects of the **clinical history of pain** include
  - the nature or quality of the chest pain (visceral)
  - precipitating factors
  - Duration (usually 5-15 minutes)
  - pain radiation and
  - the response to nitroglycerin or rest.

# Cont...

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- Ischemic chest pain may resemble pain arising from a variety of non cardiac sources, and
  - the **differential diagnosis** of anginal pain from other etiologies may be difficult based on history alone
- The patient should be asked about existing personal risk factors for CHD including
  - Smoking, HTN and DM.



# Cont...

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- A detailed **family history** should be obtained that includes information about
  - premature CHD
  - Hypertension
  - familial lipid disorders and
  - Diabetes mellitus
- There are few **signs on physical examination** to indicate the presence of CAD/complications

# Cont...

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- Findings on the cardiac examination may include
  - abnormal precordial systolic bulge
  - decreased intensity of S1
  - paradoxical splitting of S2
  - S3 (ventricular gallop), S4 (atrial gallop)
  - apical systolic murmur
  - diastolic murmur
- Non-cardiac physical findings suggesting significant cardiovascular disease include
  - abdominal aortic aneurysms or peripheral vascular disease

# Cont...

## Laboratory investigations

- **Hg** (to ensure adequate oxygen-carrying capacity)
- **FBG** (to exclude diabetes) and
- **fasting lipoprotein panel**
- **Important risk factors** in some patients may include
  - C-reactive protein
  - Increased homocysteine level
  - evidence of *Chlamydia infection* and
  - elevations in lipoprotein (a), fibrinogen and plasminogen activator inhibitor
- **Cardiac enzymes** should all be normal in stable angina.

# Cont...

## The resting ECG

- is normal in about **half** of patients with angina who are not experiencing an acute attack.
- Typical ST-T-wave changes include depression, elevation and T-wave inversion
- Variant angina is associated with ST-segment elevation, whereas silent ischemia may produce elevation or depression.
- Significant ischemia is associated with
  - ST segment depression of  $>2$  mm, exertional hypotension and reduced exercise tolerance.

# Cont...

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## **Exercise tolerance (stress) testing (ETT)**

- It is recommended for patients with an intermediate probability of CAD.
- Results correlate well with the likelihood of progressing to angina, occurrence of acute MI, and cardiovascular death.
- Ischemic ST-segment depression during ETT is
  - an independent risk factor for CV events and mortality.

# Cont...

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## Imaging studies

- Radionuclide angiocardiology
- Ultrarapid computed tomography
- Chest radiograph
- Thallium myocardial perfusion scintigraphy
- Echocardiography
- Coronary angiography

# Desired Outcome

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- **Short-term goal**
  - to reduce or prevent anginal symptoms that limit exercise capability and impair quality of life
- **Long term goals**
  - to prevent CHD events such as MI, arrhythmias, and heart failure and
  - to extend the patient's life

# Treatment

## Risk-factor Modification

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- is effective in reducing subsequent morbidity and mortality.
- Risk factors for IHD are **additive** and can be classified as alterable or unalterable.
- **Unalterable risk factors** include
  - gender, age, family history or genetic composition, environmental influences and, to some extent, diabetes mellitus.



# Cont...

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- **Alterable risk factors include**
  - Smoking,
  - hypertension, hyperlipidemia, obesity
  - sedentary lifestyle
  - hyperuricemia
  - psychosocial factors such as stress
  - the use of drugs that may be detrimental
    - e.g., progestins, corticosteroids and cyclosporine

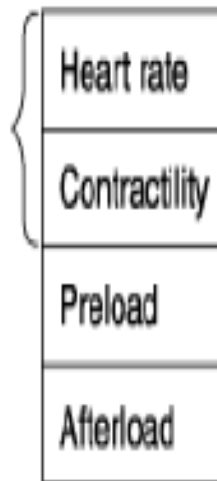
# Treatment

## Stable Exertional Angina Pectoris: Pharmacologic Therapy

### Agents decreasing O<sub>2</sub> Demand

$\beta$  adrenergic antagonists  
some Ca<sup>2+</sup> entry blockers

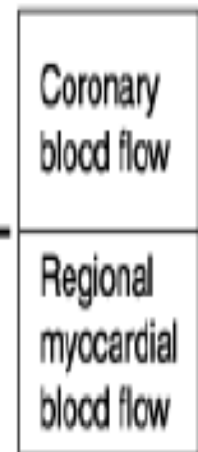
Organic nitrates  
Ca<sup>2+</sup> entry blockers



O<sub>2</sub> Demand

=

O<sub>2</sub> Supply



Also: statins,  
anti-thrombotics

Vasodilators  
(esp. Ca<sup>2+</sup> entry blockers)

### Agents increasing O<sub>2</sub> Supply

balance

ISCHEMIA

# β-Adrenergic Blocking Agents

- Decrease HR, contractility and blood pressure
  - Resulting in reduction of  $MVo_2$
- β -Blockers **do not improve oxygen supply**
  - in certain instances may lead to coronary vasoconstriction
- Improve symptoms in about 80% of patients with **chronic exertional stable angina**
  - Improve exercise duration

# Cont...

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- **Ideal candidates** for BBs include
  - patients in whom physical activity is a prominent cause of attacks
  - those with coexisting HTN, supraventricular arrhythmia or postmyocardial infarction angina
  - those with anxiety associated with anginal episodes.
- BBs may be used safely in **angina and HF**

# Cont...

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- $\beta$ -Blockade is effective in chronic exertional angina as
  - **Monotherapy** and
  - In **combination** with nitrates and/or calcium channel antagonists.
- BBs are the **first-line** drugs in chronic angina requiring daily maintenance therapy

# Cont...

- If BBs are **ineffective** or **not tolerated**, then
  - monotherapy with a calcium channel antagonist or combination therapy may be instituted
- **Reflex tachycardia** from nitrates can be blunted with BB therapy,
  - making this a useful combination
- Patients with severe angina, rest angina or variant angina may be better treated with
  - **CCBs or long-acting nitrates**

# Cont...

- Initial doses of BBs should be at the **lower end of the usual dosing range** and titrated to response.
- There is little evidence to suggest superiority of any particular BB.
- **Treatment objectives** include
  - lowering the resting HR to 50 to 60 beats/min and
  - limiting maximal exercise HR to about 100 beats/min or less.
  - HR with modest exercise should be no more than about 20 beats/min above resting HR (or a 10% increment over resting HR).

# Cont...

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- Intrinsic sympathomimetic activity appears to be **detrimental** in patients with rest or severe angina
  - because the reduction in HR would be minimized, therefore limiting a reduction in  $MVO_2$
- **Cardioselective BBs** may be used in some patients to minimize adverse effects such as
  - Bronchospasm
  - Intermittent claudication and
  - Sexual dysfunction



# Cont...

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- **Combined nonselective  $\beta$ - and  $\alpha$ -blockade** with labetalol may be useful in some patients
  - marginal left ventricular (LV) reserve
- Adverse effects of  $\beta$ -blockade include
  - hypotension, heart failure, bradycardia, heart block
  - bronchospasm
  - altered glucose metabolism
  - fatigue, malaise and depression.

# Cont...

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- **Abrupt withdrawal** in patients with angina has been associated with
  - increased **severity** and **number of pain** episodes and **MI**.
  - Tapering of therapy **over about 2 days** should minimize the risk of withdrawal reactions if therapy is to be discontinued

# Nitrates

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- The action of nitrates appears to be mainly mediated through **reduction of  $MVo_2$**  secondary to venodilation and arterial/arteriolar dilation,
  - leading to a reduction in wall stress from reduced ventricular volume and pressure.
- Nitrate therapy may be used
  - to terminate an acute anginal attack
  - to prevent effort or stress-induced attacks
  - for long-term prophylaxis, usually in combination with BBs or CCBs

# Cont...

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- Sublingual, buccal or spray nitroglycerin products are preferred
  - for alleviation of anginal attacks because of rapid absorption
- Symptoms may be prevented by prophylactic oral or transdermal products
  - usually in combination with BBs or CCBs, but development of tolerance may be problematic.

**TABLE 1 Nitrate Products**

Product	Onset (minutes)	Duration	Initial Dose
Nitroglycerin			
IV	1–2	3–5 minutes	5 mcg/min
Sublingual/lingual	1–3	30–60 minutes	0.3 mg
Oral	40	3–6 hours	2.5–9 mg three times daily
Ointment	20–60	2–8 hours	$\frac{1}{2}$ –1 inch
Patch	40–60	>8 hours	1 patch
Erythritol tetranitrate	5–30	4–6 hours	5–10 mg three times daily
Pentaerythritol tetranitrate	30	4–8 hours	10–20 mg three times daily
Isosorbide dinitrate			
Sublingual/chewable	2–5	1–2 hours	2.5–5 mg three times daily
Oral	20–40	4–6 hours	5–20 mg three times daily
Isosorbide mononitrate	30–60	6–8 hours	20 mg daily, twice daily <sup>a</sup>

<sup>a</sup>Product-dependent.

# Cont...

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- **Sublingual nitroglycerin, 0.3 to 0.4 mg,**
  - relieves pain in about 75% of patients within 3 minutes, with another 15% becoming pain-free in 5 to 15 minutes.
  - Pain persisting beyond 20 to 30 minutes after use of 2-3 nitroglycerin tablets **suggests ACS**, and the patient should be instructed to seek emergency aid.

# Cont...

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- **long-term prophylaxis of angina**
  - Chewable, oral, and transdermal products are acceptable
  - Intermittent (10 to 12 hours on, 12 to 14 hours off) transdermal nitroglycerin therapy may produce modest but significant improvement in exercise time in chronic stable angina.

# Cont...

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- **Adverse effects include**
  - postural hypotension with associated CNS symptoms
  - reflex tachycardia
  - headaches and flushing and
  - occasional nausea
  - Excessive hypotension may result in MI or stroke.
- **Noncardiovascular adverse effects include**
  - rash (especially with transdermal nitroglycerin) and
  - methemoglobinemia with high doses given for extended periods



# Cont...

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- Because both the onset and offset **of tolerance to nitrates** occur quickly,
  - one strategy to circumvent it is to provide a daily **nitrate-free interval** of 8 to 12 hours.
  - For example, ISDN should not be used more often than three times a day to avoid tolerance

# Cont...

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- **Combination therapy**

- may be combined with other drugs with complementary mechanisms of action for chronic prophylactic therapy.
- Combination generally used in patients
  - with more frequent symptoms or symptoms that do not respond to BBs alone (nitrates plus BBs or CCBs)
  - intolerant of  $\beta$ -blockers or CCBs and
  - having an element of vasospasm leading to decreased supply (nitrates with CCBs).

# Calcium Channel Antagonists(CCBs)

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- Direct actions include
  - vasodilation of systemic arterioles and coronary arteries,
    - leading to a reduction of arterial pressure and coronary vascular resistance
  - depression of myocardial contractility and the conduction velocity of the SA and AV nodes.

# Cont...

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- Verapamil and diltiazem cause **less peripheral vasodilation** than dihydro-pyridines such as nifedipine but **greater decreases in AV node conduction**.
- They must be used with **caution**
  - in patients with preexisting conduction abnormalities or
  - in patients taking other drugs with negative chronotropic properties.

# Cont...

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- $MVo_2$  is reduced with **all CCBs** primarily because of
  - reduced wall tension secondary to reduced arterial pressure.
- Overall, the benefit provided by CCBs is related to
  - **reduced  $MVo_2$**  rather than improved oxygen supply.
- In contrast to the BBs, CCBs have the potential to **improve coronary blood flow** through areas of fixed coronary obstruction
  - by inhibiting coronary artery vasospasm.

# Cont...

- **Good candidates** for CCBs include patients with
  - contraindications or intolerance to BBs
  - coexisting conduction system disease (excluding the use of verapamil and possibly diltiazem),
  - Prinzmetal angina
  - peripheral vascular disease
  - severe ventricular dysfunction and
  - concurrent hypertension
- Amlodipine is probably the agent of choice in severe ventricular dysfunction
  - the other dihydropyridines should be used with caution if the EF is less than 40%.

# Ranolazine

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- The mechanism of action of ranolazine has **not been determined**,
  - but it may be related to **reduction in calcium overload in ischemic myocytes** through inhibition of the late sodium current.
- Ranolazine is indicated for the treatment of **chronic angina**.
- It **should be used in combination** with amlodipine,  $\beta$ -blockers or nitrates.

# Cont...

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- Ranolazine should be
  - started at 500 mg twice daily and
  - increased to 1,000 mg twice daily if needed based on symptoms.
- The most common adverse effects are **dizziness, headache, constipation, and nausea**
- Because it **prolongs the QT interval**, ranolazine should be reserved
  - for patients who have not achieved an adequate response to other antianginal drugs.



# Some more Recommendations

## Stable Exertional Angina Pectoris

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- After assessing and manipulating alterable risk factors,
  - a **regular exercise** program should be undertaken with caution in a **graduated fashion** and with **adequate supervision** to improve cardiovascular and muscular fitness.

# Cont...

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- **Nitrate therapy** should be the first step in managing acute attacks of chronic stable angina
  - if the episodes are **infrequent** (e.g., a few times per month).
- If angina occurs **no more often than once every few days**,
  - then sublingual nitroglycerin tablets or spray or buccal products may be sufficient.

# Cont...

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- For **exercise prophylaxis** when undertaking activities that predictably precipitate attacks,
  - nitroglycerin 0.3 to 0.4 mg sublingually may be used about 5 minutes prior to the time of the activity.
  - Nitroglycerin spray may be useful when inadequate saliva is produced to rapidly dissolve sublingual nitroglycerin
  - The response usually lasts about 30 minutes

# Cont...

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- When angina occurs more **frequently**,
  - chronic prophylactic therapy should be instituted.
  - $\beta$ Bs may be preferable because of less frequent dosing and other desirable properties
    - potential cardio-protective effects
    - antiarrhythmic effects
    - lack of tolerance
    - antihypertensive efficacy

# Cont...

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- An agent should be selected that is well tolerated by individual patients at a reasonable cost.
- Patients most likely to respond well to  $\beta$ -blockade are those with
  - a high resting HR and
  - a relatively fixed anginal threshold (i.e., their symptoms appear at the same level of exercise or workload on a consistent basis)

# Cont...

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- CCBs may also be used instead of BBs for chronic prophylactic therapy.
- They are as effective as BBs and are most useful in patients who have a **variable threshold for exertional angina**
- CCBs may provide better skeletal muscle oxygenation, resulting in decreased fatigue and better exercise tolerance.

# Cont...

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- They can be used safely in many patients with contraindications to BB therapy.
- The available drugs have similar efficacy in the management of chronic stable angina.
- Patients with conduction abnormalities and moderate to severe LV dysfunction ( $EF < 35\%$ )
  - should not be treated with verapamil, whereas amlodipine may be used safely in many of these patients.

# Cont...

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- **Diltiazem**

- has significant effects on the AV node and
- can produce heart block in patients with preexisting conduction disease or when other drugs with effects on conduction (e.g., digoxin, BBs) are used concurrently.

- **Nifedipine**

- may cause excessive HR elevation, especially if the patient is not receiving a BB, and this may offset its beneficial effect on  $MVO_2$



# Cont...

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- The **combination of CCBs and BBs** is rational because the hemodynamic effect of CCBs is complementary to  $\beta$ -blockade.
  - However, combination therapy may not always be more effective than single-agent therapy.

# Cont...

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- **Chronic prophylactic therapy**
  - with long-acting forms of nitroglycerin (oral or transdermal), ISDN, ISMN, and pentaerythritol trinitrate may also be effective when angina occurs more than once a day
  - but development of tolerance is a limitation.
  - Monotherapy with nitrates should not be first-line therapy unless BBs and CCBs are contraindicated or not tolerated

# Cont...

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- **A nitrate-free interval of 8 hours** per day or longer should be provided to maintain efficacy.
- Dose titration should be based on changes in the DP.
- The choice among nitrate products should be based on
  - experience, cost and patient acceptance.

Recommendations	Recommendation Grades <sup>a</sup>
All patients should be given the following unless contraindications exist:	
• Aspirin	Class I, Level A
• $\beta$ -Blockers with prior MI	Class I, Level A
• Angiotensin-converting enzyme inhibitor (ACEI) to patients with CAD and diabetes or LV dysfunction	Class I, Level A
• LDL-lowering therapy with CAD and LDL >130 mg/dL	Class I, Level A
• Sublingual nitroglycerin for immediate relief of angina	Class I, Level B
• Calcium antagonists or long-acting nitrates for reduction of symptoms when $\beta$ -blockers are contraindicated	Class I, Level B
• Calcium antagonists or long-acting nitrates in combination with $\beta$ -blockers when initial treatment with $\beta$ -blockers is unsuccessful	Class I, Level C
• Calcium antagonists or long-acting nitrates as a substitute for $\beta$ -blockers if initial treatment with $\beta$ -blockers leads to unacceptable side effects	Class I, Level A
Clopidogrel may be substituted for aspirin when aspirin is absolutely contraindicated	Class IIa, Level B
Long-acting nondihydropyridine calcium antagonists instead of $\beta$ -blockers as initial therapy	Class IIa, Level B
ACEIs are recommended in patients with CAD or other vascular disease	Class IIa, Level B
Low-intensity anticoagulation with warfarin, in addition to aspirin, is recommended but bleeding would be increased	Class IIb, Level B
Therapies to be avoided include:	
• Dipyridamole	Class III, Level B
• Chelation therapy	Class III, Level B

CAD, coronary artery disease; LDL, low-density lipoprotein; LV, left ventricular; MI, myocardial infarction.

<sup>a</sup>American College of Cardiology and American Heart Association Evidence Grading System. Recommendation Class:

# Treatment of Coronary Artery Spasm and Variant Angina Pectoris

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- All patients should be treated for acute attacks and maintained on prophylactic treatment for **6 to 12 months** after the initial episode.
- Aggravating factors such as **alcohol or cocaine use and cigarette smoking should be stopped.**
- Nitrates
  - are the mainstay of therapy, and most patients respond rapidly to sublingual nitroglycerin or ISDN.
  - IV and intracoronary nitroglycerin may be useful for patients not responding to sublingual preparations

# Cont...

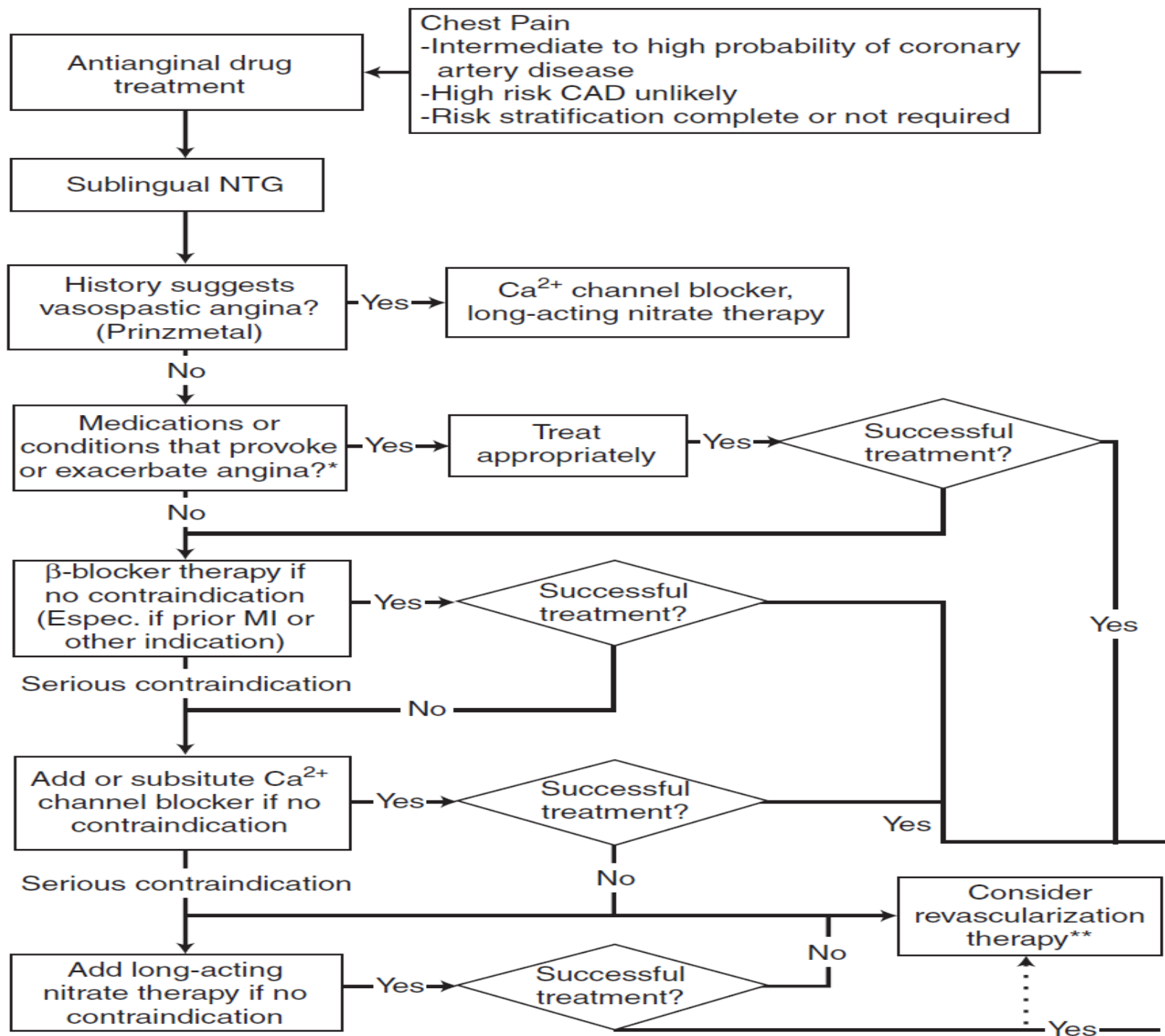
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- Because CCBs may be more effective, have few serious adverse effects, and can be given less frequently than nitrates,
  - some authorities consider them the agents of choice for variant angina.
  - Nifedipine, verapamil, and diltiazem are all equally effective as single agents for initial management.
  - Patients unresponsive to CCBs alone may have nitrates added.

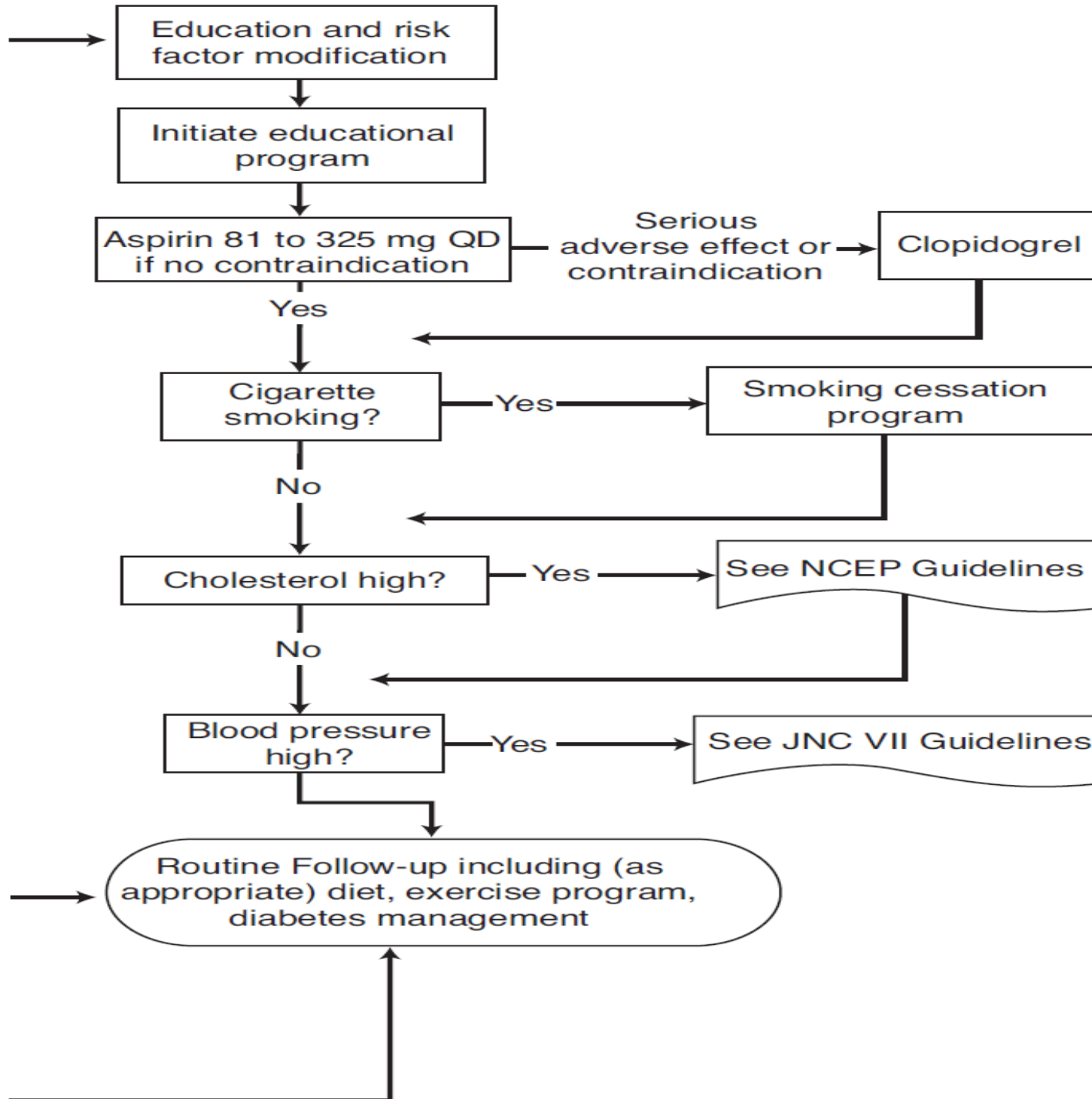
# Cont...

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- **Combination** therapy with nifedipine plus diltiazem or nifedipine plus verapamil
  - is reported to be useful in patients **unresponsive** to **single-drug** regimens.
- BBs have little or no role in the management of variant angina
  - as they may induce coronary vasoconstriction and prolong ischemia.







**\*\***At any point in this process, based on coronary anatomy, severity of anginal symptoms, and patient preferences, it is reasonable to consider evaluation for coronary revascularization. Unless a patient is documented to have left main, three-vessel, or two-vessel coronary artery disease with significant stenosis of the proximal left anterior descending coronary artery, there is no demonstrated survival advantage associated with revascularization in low-risk patients with chronic stable angina; thus, medical therapy should be attempted in most patients before considering PTCA or CABG.

# Evaluation Of Therapeutic Outcomes

- **Subjective measures** of drug response include
  - the number of painful episodes
  - amount of rapid-acting nitroglycerin consumed and
  - patient-reported alterations in activities of daily living
    - time to walk two blocks, number of stairs climbed without pain
- **Objective clinical measures** of response include
  - HR, blood pressure and the DP as a measure of  $MVo_2$

# Cont...

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- **Objective assessment** also includes
  - the resolution of ECG changes at rest, during exercise or with ambulatory ECG monitoring.
- Monitoring for **major adverse effects** should be undertaken they include
  - headache and dizziness with nitrates
  - fatigue and lassitude with BBs and
  - peripheral edema, constipation and dizziness with CCBs

# Cont...

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- The **ECG** is very useful,
  - particularly if the patient is experiencing chest pain or other symptoms thought to be of ischemic origin.
  - ST-segment deviations are very important, and the extent of their deviation is related to the severity of ischemia.

# Cont...

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- **ETT** may also be used
  - to evaluate the response to therapy, but the expense and time needed to perform this test preclude its routine use.
- A **comprehensive plan** includes
  - ancillary monitoring of lipid profiles, fasting plasma glucose, thyroid function tests, hemoglobin/hematocrit and electrolytes

# Case study

RG is a 68-yo female who presents to the clinic with c/c chest pain. It occurs while she is gardening and is relieved with rest. She has a PMH of HTN. Current meds include metoprolol 25 mg BID and HCTZ 25 QD. Current vitals are: BP: 128/78, P: 70, RR: 12.

Which of the following treatments would be appropriate for this patient?

- A. Increase metoprolol to 50 mg BID
- B. Start aspirin 81 mg QD
- C. Start amlodipine 2.5 mg QD
- D. A and B

