Management of Coronary Artery Disease in India

Consensus Document 2006

Summary

Indian patients differ from western patients by way of having

- Higher prevalence of Diabetes Mellitus.
- Diffuse CAD or multiple plaques.
- Lower economic status.
- Lower affordability for repeat procedures.
- Onset of disease at a younger age.

Factors that influence decision making should include

- Clinical syndromes.
- Response to medication.
- Extent of disease.
- Socioeconomic factors.
- Age of the patient.
- Presence or absence of diabetes.
- Access to quality medical care.
- Mode of payment.

One tends to chose PCI in a younger patients in view of the disease progression

- CABGS is often preferred in diabetics in view of multiple plaques and higher restenosis with PCI.
- Both PCI and OPCAB can be done safely with low morbidity and mortality.
- Individual patients have to be advised based on all available facts including the potential need for repeat procedures with PCI.
- Final treatment decisions have to be made after thorough discussion about the pros and cons of alternative treatment modalities.
- Guidelines from Western countries which do not mention about the cost factors are difficult to apply directly in Indian context.
- Large RCTs are expensive and require lot of resources to conduct.
- Online nation-wide registries can be done easily at a lesser expense and would give important insights in CAD in India.
- This has to be done urgently by cardiologists and cardiac surgeons of India.

Committee

Chair: Dr. N Trehan, Delhi

Co-ordinator: Dr. VK Chopra, Delhi

Dr. S Chandra, Bangalore	Dr. D Pahlajani, Mumbai
Dr. KM Cherian, Chennai	Dr. R Panda, Mumbai
Dr. P Dandona, New York	Dr. M Panja, Kolkata
Dr. Enas B Enas, Chicago	Dr. SK Parashar, Delhi
Dr. S Hiremath, Pune	Dr. K Parikh, Ahmedabad
Dr. AK Kar, Kolkata	Dr. BS Raju, Hyderabad
Dr. RR Kasliwal, Delhi	Dr. KS Reddy, Delhi
Dr. U Kaul, Delhi	Dr. M Samuel, Chennai
Dr. TS Kler, Delhi	Dr. D Shetty, Bangalore
Dr. V Mohan, Chennai	Dr. KK Talwar, Chandigarh
Dr. KG Nair, Mumbai	Dr. S Thanikachalam, Chennai

Preface

It is well known that coronary artery disease is more prevalent and behaves in a more virulent manner in Indians than in any other ethnic group. This is because of our genetic make-up, our characteristic lipid abnormalities and high incidence of diabetes mellitus leading to more diffuse disease. A high incidence of renal insufficiency often co-exists.

Additionally, there are socioeconomic factors, lack of insurance for a vast majority of patients, inadequate medical facilities in vast areas and a huge difference in the quality of medical care available in the different regions of our country. While the guidelines written by the ACC/AHA and the European guidelines are based on solid scientific data and are largely accepted throughout the world, are they applicable in their entirety or do we need to modify some of them for our population, has been a subject of debate in the medical fraternity for quite some time. To address these issues, a consensus panel was formed early 2006, consisting of experienced cardiologists and cardiac surgeons representing different regions of our country. All available published literature from our country was analyzed and after the initial discussions, it was decided to split the panel into three groups: the first, to formulate recommendations for primary and secondary prevention; the second, for management of acute coronary syndromes; and the third, for interventional strategies, catheter based and surgical. After several meetings, the entire panel met again where the recommendations of all three groups were presented, debated and finalized. These were also forwarded to several international experts and their inputs were incorporated wherever found feasible. This document was presented at the annual scientific session of the Cardiological Society of India, 2007.

This effort would be worthwhile only if it translates into a better quality of care for our patients. Keeping this in mind, we decided to make available this document to our colleagues across the country, in a simple, easy to understand and practical format. It gives me great pleasure to present this booklet to you with the hope that you will find it useful in managing your patients according to evidence-based data.

Dr. Naresh Trehan

Conclusion

- These are combined guidelines in contrast to other guidelines.

- Indications are classified differently.

- Socioeconomic factors are taken into consideration in addition to pure scientific merit.

Associated Surgical Techniques

LV Restoration

- Ventricular restoration by septal exclusion in patients with severe LV dysfunction is associated with significant improvement in left ventricular function.

Ischaemic MR

- Repair of Ischaemic MR using annuloplasty is associated with low morbidity and mortality.

Post operative ICU stay is reduced with LV restoration and correction of ischaemic MR.

Emerging surgical techniques

Coapsys mitral annuloplasty for chronic functional MR

- This system is effective in reducing ischaemic MR and improving NYHA Class.
- Procedure done without CPB.

Robotically enhanced CABG

- It is safe and suitable for single-and-two vessel disease.
- More expensive.
- More time consuming.

Introduction

Cardiovascular disease (CVD) includes coronary artery disease, cerebrovascular disease and peripheral vascular disease. Indians have a three times higher risk of developing CVD compared to Chinese and Whites and are 20 times more likely to die due to CVD compared to native black South Africans. Moreover, Indians also tend to develop CVD one decade earlier compared to Europeans. This predilection for CVD among Indians was reported 50 years ago, and was confirmed by several studies. In India, approximately 2.78 million deaths are due to cardiovascular disease, representing over 50% of all deaths, making CVD the number one killer disease in our country. The prevalence of CVD in Indians has been escalating in alarming proportions in the last few decades. The prevalence of heart disease in the 1950's was 1.05%; this increased to 9.7% in 1990 and to 11.0% by 2000 in urban populations. This rising trend in CVD will shortly make India, the leader in CVD death rates also.

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Prevention of Cardiovascular Diseases

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Based on the Consensus Document on
the Management of Coronary Artery Disease in India

Lead: **Dr. V Mohan, Chennai**

Dr. KM Cherian, Chennai

Dr. VK Chopra, Delhi

Dr. Paresh Dandona, New York

Dr. Enas B Enas, Chicago

Dr. Shirish Hiremath, Pune

Dr. RR Kasliwal, Delhi

Dr. KG Nair, Mumbai

Dr. M Panja, Kolkata

Dr. SK Parashar, Delhi

Dr. KS Reddy, Delhi

Strategies to Prevent Postoperative Stroke following CABGS

- Preoperative evaluation of carotid arteries using Doppler study.

- Intraoperative TEE and epiaortic scanning for location of atheroma of the ascending and arch of aorta for locating the suitable site for side-clamping of the aorta for proximal anastamosis.

- Off-pump technique.

- Use of bilateral IMAs/composite *in situ* pedicle graft in patients with atherosclerosis of aorta.

Angina - Post CABG

- The number of patients coming after prior CABG is increasing.

- Whenever feasible, PCI of native vessels is the treatment of choice.

- Distal occlusion devices rather than IIb/IIIa receptor blockers decrease the complication of PCI to SVG grafts.

- In selected patients, Redo CABGS is associated with less mortality and postoperative morbidity.

- Redo CABGS is indicated in

  – Disabling angina despite maximal noninvasive therapy and when PCI is not possible.

  – Bypassable distal vessel(s) with a large area of threatened myocardium and when arterial grafts can be given.

CABG in ACUTE STEMI

Treatment of choice in

- Acute STEMI, complicated by cardiogenic shock and when coronary anatomy is not suitable for PCI.

- Acute STEMI with mechanical complications necessitating surgery.

May be considered in

- Patient with acute STEMI with ongoing ischaemia or infarction that is not responsive to maximum nonsurgical therapy.

Contra-indicated in

- As primary reperfusion technique in late (> 9-12 hours) evolving ST segment elevation without ongoing ischaemia.

CABG for failed PCI

Treatment of choice in

- Ongoing ischaemia or threatened occlusion with significant myocardium at risk.

- Patient has haemodynamic compromise.

May be considered in

- Haemodynamically compromised patients without impaired coagulation system.

Contra-indicated in

- Absence of Ischaemia.

- Inability to revascularize owing to target anatomy or no-reflow state.

Subjects at high risk for CVD

1. Age $\leq$35 years for men and $\geq$45 years for women.*

2. Coronary artery disease (or) stroke (or) atherosclerotic peripheral artery disease (or) evidence of atherosclerosis (or) personal history of diabetes.

3. Strong family history of diabetes[#] (or) stroke (or) coronary artery disease (or) atherosclerotic peripheral artery disease.

4. Smoking (or) tobacco use in any form.

5. Obesity: Body mass index (BMI) $\geq$23 kg/m^2 (and/or) Abdominal obesity: waist circumference $\geq$90 cm for males and $\geq$80 cm for females.**

6. History of high blood pressure/hypertension or BP $\geq$140/90 mm Hg.

7. Known diabetic or person having the following values: fasting plasma glucose $\geq$126 mg/dL (or) 2-hour post-load plasma glucose $\geq$200 mg/dL or a random blood sugar $\geq$200 mg/dL.

8. Pre-diabetes: Impaired Fasting Glucose (IFG): fasting plasma glucose $\geq$ 100 mg/dL & <126 mg/dL or Impaired Glucose Tolerance (IGT): fasting plasma glucose <126 mg/dL and 2 hour post load plasma glucose $\geq$ 140 mg/dL and <200 mg/dL.

9. Dyslipidaemia: Serum cholesterol $\geq$200mg/dL (or) LDL cholesterol $\geq$130 mg/dL (or) triglycerides $\geq$150mg/dL (or) Non-HDL cholesterol $\geq$160 mg/dL (or) HDL cholesterol <40mg/dL in men or <50 mg/dL in women (or) Cholesterol/HDL ratio $\geq$5. 0 (or) Triglyceride/HDL ratio $\geq$3.0.***

10. Metabolic syndrome as defined by NCEP (or) WHO (or) IDF criteria.

11. Unhealthy lifestyle: Physical inactivity (sedentary lifestyle: exercise <30 min for < 2 days a week) (or) unhealthy diet (excess fat (or) calorie intake (or) low fruit and vegetable consumption) and/or psychosocial factors: depression and/or stress/hostility.

Risk Stratification

High risk	>3 risk factors (or) history of diabetes (or) stroke (or) coronary artery disease (or) atherosclerotic peripheral artery disease.
Medium risk	>2 risk factors other than those specified in high risk category.
Low risk	<2 risk factors other than those specified in high risk category.

* AHA has recommended 45 years for men and 55 years for women. Since Indians tend to develop premature CVD, age has been modified accordingly.
** WHO Asia Pacific Guidelines for obesity.
*** Triglyceride/HDL ratio $\geq$3.0 has the optimum sensitivity and specificity in predicting small dense LDL.
\# Strong family history means either/or both parents are affected.

Tests recommended for confirming cardiovascular risk

Tests

- ECG examination/stress test/CT angiography.
- Oral glucose tolerance/fasting plasma glucose/random blood sugar.
- Lipid profile:

  Estimation of serum cholesterol+HDL cholesterol+Triglycerides and calculation of non-HDL cholesterol and LDL cholesterol.

  Estimation of Apo-lipoprotein A and Apo-lipoprotein B.
- Hb/CBC/serum creatinine/uric acid/microalbuminuria.

Time line schedule for screening for risk factors

Adults aged ≥25 years

1. Risk assessment should be done as recommended in above table.
2. If the individual has low risk:

   Risk assessment must be repeated once in three years.

   If the individual has medium to high risk:

   Risk assessment must be repeated annually.
3. Blood pressure must be monitored at every visit.

Adults aged ≥35 years

1. Risk assessment as recommended in above table.
2. In addition, blood pressure must be monitored at every visit.
3. Risk assessment must be repeated annually.

Indications for CABG in Stable Angina and ACS

Treatment of choice in

- Significant left main coronary artery stenosis (≥50% stenosis).
- Left main equivalent: Significant (≥70%) stenosis of proximal LAD and proximal left circumflex artery.
- Three-vessel disease with compromised LV function (LVEF<0.50).
- Three-vessel disease with significant angina and large area of myocardium at jeopardy.
- Two-vessel disease with significant proximal LAD stenosis and either LVEF<0.50 or diabetes mellitus.

May be considered in

- Proximal LAD stenosis with one-or-two vessel disease.
- One-or-two vessel disease not involving the proximal LAD in severely symptomatic patients with lesions not suitable for PCI.

Contra-indicated in

- One or two vessel disease not involving significant proximal LAD and no demonstrable ischaemia on noninvasive testing.
- Borderline coronary stenosis (50%–60% diameter in locations other than LMCA and proximal LAD stenosis and no demonstrable ischaemia on noninvasive testing).
- Insignificant coronary stenosis (<50% diameter).

CABGS in India

The most frequently performed cardiac surgery.

Total No. of CABGs per annum	:	42,500
Off-pump CABG	:	26,000
On-pump CABG	:	16,500

Mortality

Off-pump	:	0–1% (Low risk group)
	:	1–2% (High-risk)
On-pump	:	0–1.5%

Morbidity

CVA	:	0.14–0.5% (Off-pump)
	:	3–7% (On-pump)
Renal failure	:	0–0.5% (Off-pump)
	:	0.5–1 % (On-pump)

Off-pump CABG - Potential Advantages

- Similar completeness of revascularization and graft patency has to be achieved.
- OPCAB reduces the duration of ventilation, ICU and hospital stay, resource utilization.
- OPCAB is more renoprotective.
- OPCAB minimizes mid-term cognitive dysfunction.
- OPCAB can be considered as a better alternative to on-pump surgery.
- In observational studies, mortality and perioperative morbidity are less compared to on-pump surgery. However, superiority of off-pump surgery has to be proven in large randomized controlled trials with sufficient statistical power.

Composition of Heart Friendly Diet [HFD]*

Coloured/nutritious diet[#]	Dark green (or) deep orange (or) yellow fruits and vegetables are recommended. More than 5 servings a day combined (1 serving=1/2 a cup).
Include	Whole grain cereals, vegetables and fruits, fish, legumes, low-fat dairy products, lean meats and nuts.
Limit	Salt and sugar, fried foods, red meat, butter, ghee, vanaspathi, sweets, chocolates, ice-creams, bakery products like muffins, cakes, pastries and cream biscuits.
Avoid	Alcohol.
Vegetables and fruits	8–10 servings a day combined (1 serving =1/2 a cup).
Salt	<6 g/day.
Fibre	20–30 g/day.
Cholesterol	<300 mg/day.
Saturated fat	<7% of total calories.
Polyunsaturated fat	Up to 10% of total calories.
Monounsaturated fat	Up to 20% of total calories.
Trans fat	<1% of total calories (as low as possible).
Total fat	20–30% of total calories.[@]
Carbohydrate	50–60% of total calories (40–50% in those with diabetes or metabolic syndrome).
Protein	~15% of total calories.

* Also called Therapeutic Heart Diet (THD) or Smart Heart Diet (SHD), this is also called TLC or Therapeutic Lifestyle Changes by NCEP.

[@] WHO/NIN workshop report.

[#] Example of coloured foods:
Dark green-Spinach, Broccoli, Capsicum and all green leafy vegetables.
Deep orange and red-Orange, Mango, Carrots, Tomato, Red Capsicum and Papaya.
Yellow - Mango, Pumpkin, Peaches, Lime, and Yellow Capsicum.

Tips for healthy diet

Foods rich in saturated fat
- Butter
- Ghee
- Vanaspathi
- Palm oil
- Coconut oil
- Whole milk
- Whole milk dairy products
- Cheese
- Cream cheese
- High-fat meats
- Fried foods

Oils rich in MUFA
- Groundnut oil
- Olive oil
- Mustard oil

Foods rich in Cholesterol
- Egg yolk
- Chicken skin
- Liver and other organ meats
- Full-fat dairy products

Oils rich in MUFA & PUFA
- Gingelly oil
- Rice bran oil

Oils rich in PUFA
- Corn oil
- Sunflower oil

Food rich in omega-3 fatty acids
- Fish

PUFA vs. MUFA
- Increased use of PUFA-rich oil reduces HDL
- MUFA-rich oil does not affect HDL

Recommended oil consumption pattern
- PUFA-rich oil for seasoning
- MUFA-rich oil for frying
- Reusing of heated oils are not recommended, instead use them for seasoning
- 500g of oil can be consumed per person per month

Cooking methods that tend to produce lower saturated fat levels
- Bake
- Microwave
- Shallow fry instead of deep frying
- Lightly stir-fry

- Buy fruits and vegetables to eat as snacks, desserts, salads, side dishes & main dishes.
- Display fresh fruits in a bowl in the kitchen to make fruit easier to grab as a snack.
- Serve fresh fruit for dessert or freeze (banana, berries, melon, grapes) for a delicious frozen treat.
- Buy low or nonfat yogurt; like many other dairy foods, it is an excellent source of protein and calcium.

Guidelines for CABGS

Operator Competency

- Ideally, each interventionist should do at least 50 procedures per year

- Those who do less than that number per year should not do independently in a centre without the presence of another experienced senior interventional cardiologist

- To do primary PCI, individual operators should be doing at least 10 such cases per year

- Adequately trained nursing and technical staff should be present

Institutional and Operator Competency for Primary PCI

- Balloon dilation within 90 min of admission and diagnosis of STEMI.

- TIMI 2–3 flow attained in more than 90% of patients.

- Emergency CABG rate less than 2% among all patients undergoing the procedure.

- Actual performance of PCI in 85% of patients brought to the laboratory.

- Risk–adjusted in-hospital mortality rate less than 7% in patients without cardiogenic shock.

Life style related risk factors & goals to treat

Risk Factor	Smoking/ Tobacco Use	Obesity (or) abdominal obesity	Physical Activity	Unhealthy Diet	Stress and Depression
Goal	Cessation	Body mass index: <23 kg/m ^{2} Waist circumference: Men <90 cm; Women <80 cm.	At least 30 minutes of moderate intensity physical activity minimum of five days a week.	Healthy diet: Low calorie –low fat, low sugar –high fibre diet.	Stress reduction.
Lifestyle intervention* * Refer to Heart Friendly Diet	Counseling/ rehabilitation	Initiate weight management program with healthy diet and physical activity. To start with, fix realistic targets of 5–10 % weight loss, then slowly work towards goal. Monitor waist girth (inch tape)# and weight (weighing scale) once in a month. #Waist girth is the smallest horizontal distance between the costal margins and the iliac crests at minimal respiration.	Subjects with respiratory, orthopaedic, renal or neurological problems must consult physician before initiating physical activity. Moderate intensity exercise: Brisk walking, Exercise, Aerobics (or) Jogging for 30 minutes. Vigorous intensity activity to be encouraged as it has additional benefits. Yoga and exercise can be combined together.	Advise: whole grains, vegetables and legumes, low fat, lean meats. Reduce: saturated fat, cholesterol and trans fatty acids. Substitute: refined grains with whole grains. Avoid: deep frying, vanaspathi oil and bakery items. Decrease salt intake.	Counseling, changes in lifestyle, relaxation techniques. Quality of sleep. Meditation/ yoga.
Clinical intervention	Nicotine patch, Buspirone, etc.	In morbid obesity, consider pharmacotherapy and/or bariatric surgery.			If lifestyle fails, consider pharma- cological intervention.

Diabetes and hypertension - goals to treat

Risk Factor	Smoking/Tobacco Use	Obesity (or) abdominal obesity
Goal	Blood pressure: <140/90 mmHg**	Fasting plasma glucose <110 mg/dL; Postprandial plasma glucose <140 mg/dL; HbA₁C <6.5%
Lifestyle intervention* *Refer to Heart Friendly Diet*	Healthy diet (HFD) with reduction in salt intake (<6 g/day for normal population; <3 g/day for hypertensives). Avoid alcohol. Increase physical activity. Subjects with renal insufficiency/heart failure must consult physician before initiating physical activity.	Meal plan and exercise.
Clinical intervention	Initiate drug therapy for subjects with ≥140/90 mmHg, if 6 months of lifestyle intervention is not effective or if additional risk factors are present.	If lifestyle alone is inadequate to achieve glycaemic targets, initiate oral drugs, add insulin if oral drugs are inadequate to achieve targets. Management guidelines formulated by Indian Council Medical Research (ICMR) to be followed. Website: www.icmr.nic.in/guidelines_diabetes/guide_diabetes.htm

\# Individualized treatment based on the clinical condition of the patient is left to the option of the physician.

** Titrate to goal of 130/80 mmHg in those with diabetes and 120/75 mmHg for subjects with diabetic nephropathy or renal insufficiency.

Institutional competency

- Procedures should be done only at centres with adequate infrastructure.
- These include ability to do an emergency coronary artery by pass surgery on site.
- The supportive services include a good ICCU setting, blood bank and a reliable and validated laboratory.
- Competent and nursing and technical staff have to be present.
- The catheterization laboratory should be of good quality imaging and should have adequate stock of various catheters, wires and stents including covered stents.
- Each centre should have a turnover of at least 100 PCI procedures per annum.
- Ideally, low volume centres within a city should pool up and combine their resources at one place to make the PCI procedures safe and cost-effective.
- Ideally each centre should be given accreditation to perform PCIs and they have to be renewed periodically based upon inspections and quality control.
- Reporting of the number of cases have to be done and outcomes have to be made mandatory rather than voluntary.
- There should be a periodic audit of PCI procedures done within an institution with peer review of the cases done.
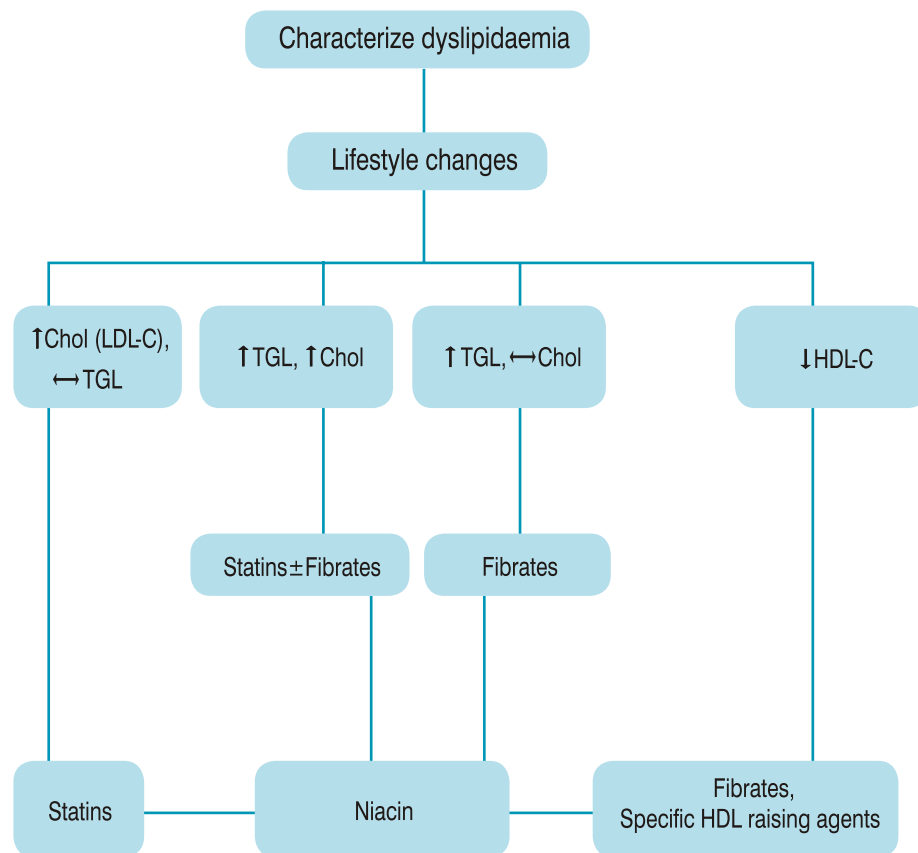
Angiographic

- Ostial lesions.

- Bifurcation lesions.

- ULM lesion.

- SVG lesion.

- Severe calcification.

- Angiographic thrombus.

- Severe tortuosity.

- Occluded vessel.

Dyslipidaemia - primary prevention- goals to treat

Risk Factor	Hypercholesterolaemia (or) High LDL levels (or) High Non–HDL levels	Hypertriglyceridaemia	Combined Lipidaemia
Definition	Cholesterol ≥200 mg/dL (or) LDL cholesterol ≥130 mg/dL. Non-HDL cholesterol ≥160 mg/dL.	Triglycerides ≥150 mg/dL Low HDL levels. HDL cholesterol <40 mg/dL in men; <50 mg/dL in women.	Triglycerides ≥150 mg/dL. Cholesterol ≥200 mg/dL. LDL cholesterol ≥130 mg/dL. Cholesterol/HDL ratio ≥5.0. Triglyceride/HDL ratio ≥3.0. Non-HDL cholesterol ≥160 mg/dL.
Target	Cholesterol <200 mg/dL LDL cholesterol <130 mg/dL Non-HDL cholesterol <160 mg/dL. Optional goal of <130 mg/dL in people with metabolic syndrome.	Triglycerides <150 mg/dL HDL cholesterol. ≥40 mg/dL in men; >50 mg/dL in women.	Goals similar to that of hypercholesterolaemia, hypertriglyceridaemia, low HDL levels and high LDL levels. Non-HDL cholesterol <160 mg/dL. Optional goal of<130 mg/dL in people with metabolic syndrome.
Lifestyle intervention* *Refer to Heart Friendly Diet*	Heart friendly diet [HFD]: Decrease intakes of saturated fats (<7% of total calories) and cholesterol (<200 mg/d) in overall composition of diet. Increase fiber (10–25 g/d) intake LDL lowering dietary options plant stanols/sterols (2 g/d) and increased viscous (soluble) fiber (10–25 g/d). Weight reduction. Increased physical activity.#	Heart friendly diet (HFD)	Heart friendly diet (HFD)
Clinical intervention	If 6 weeks of lifestyle intervention fails, consider drug therapy –statins.	If 6 weeks of lifestyle intervention fails, consider drug therapy–niacin or fibrates.	If 6 weeks of lifestyle intervention fails, consider drug therapy: statins [Atorvastatin/ Rosuvastatin (plus niacin/fibrate if HDL is low)].

A combination of yoga and exercise is recommended.

Algorithm for lipid management

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        ┌────────────────────────────┐
        │ Characterize dyslipidaemia │
        └────────────────────────────┘
                      │
          ┌──────────────────────┐
          │   Lifestyle changes  │
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| ↑Chol (LDL-C), ↔TGL | ↑TGL, ↑Chol | ↑TGL,↔Chol | ↓HDL-C |

| | Statins±Fibrates | Fibrates | |

| Statins | Niacin | Fibrates, Specific HDL raising agents |

↔ Normal (cholesterol <200 mg/dL; triglycerides <150 mg/dL; HDL-cholesterol, men >40 mg/dL, women >50 mg/dL).

↑ Increase, ↓ Decrease.

When to start statin/fibrates:

In non-diabetic subjects, cholesterol ≥250 mg/dL and triglycerides ≥200 mg/dL.

In diabetic subjects, cholesterol ≥200 mg/dL and triglycerides ≥150 mg/dL.

Drug Eluting Stents

- Decrease Binary restenosis.
- Increased late stent thrombosis.
- Need prolonged, possibly continued dual antiplatelet therapy.
- All DES may not be the same.
- More data from long term follow-up studies is needed to make definite recommendations.
- Physicians have to make decisions based on lesion and patient specific factors.

Drug Eluting Stents: Demonstrated Benefit

The subsets of patients benefiting with DES include: Diabetics.

- Diabetes
- Small vessel size.
- Long lesions.
- Multiple stents.

Drug Eluting Stents: Specific Exclusions in Landmark RCTs

Clinical

- MI within 48 hours.
- LV ejection fraction (LVEF) <25%.
- Previous or planned use of brachytherapy.
- Previous PCI of the same lesion.
- Coexisting medical conditions likely to limit life expectancy.
- Contraindications to aspirin, thienopyridines, or stent substances.
- Severe renal or haematologic comorbidity.

Glycoprotein IIb/IIIa Inhibitors

Used in unstable lesions, threatened vessel closure and slow or no reflow phenomena or visible thrombus.

In view of their cost and risk of bleeding, they are not used routinely.

Should be used in

• Patients with high risk unstable angina or NSTEMI not pretreated with clopidogrel.

May be considered in

• Primary PCI for STEMI (Abciximab preferred).

• Unstable Angina or NSTEMI pretreated with clopidogrel.

• Elective PCI.

High risk patients – goals to treat

For patients with heart disease/stroke + diabetes/metabolic syndrome/tobacco abuse

Parameter	Goals
Fasting plasma glucose	<110 mg/dL
Postprandial plasma glucose	<140 mg/dL
Total cholesterol	<160 mg/dL
Non-HDL cholesterol	<100 mg/dL
Triglycerides	<130 mg/dL
LDL cholesterol	<70 mg/dL
HDL cholesterol	>50 in women and >45 in men
Waist circumference	<80 cm in women and <90 cm in men
Blood pressure	<120/80 mmHg
Physical activity	45–60 min/day
Tobacco	Zero

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Dr. KK Talwar, Chandigarh

Dr. S Thanikachalam, Chennai

Use of Adjunctive Drugs:
Aspirin and Clopidogrel

- Patients already taking daily chronic aspirin therapy should take 75–325 mg of aspirin before the PCI procedure is performed.

- Patients not already taking daily chronic aspirin therapy should be given 300–325 mg of aspirin at least 2 hours and preferably 24 hours before the PCI procedure is performed.

- After the PCI procedure, aspirin 325 mg daily should be given for at least 1 month after bare-metal stent implantation, 3 months after sirolimus-eluting stent implantation and 6 months after paclitaxel-eluting stent implantation, after which daily chronic aspirin use should be continued indefinitely at a dose of 75–162 mg.

- A loading dose of clopidogrel should be administered before PCI is performed.

- An oral loading dose of 300 mg, administered at least 6 hours before the procedure, or 600 mg at least 2 hours before the procedure.

- In patients who have undergone PCI, clopidogrel 75 mg daily should be given for at least 1 month after bare-metal stent implantation.

- Possibly indefinitely when DES are used.

Early PCI in Patients after Successful Fibrinolysis

Treatment of choice in

- Recurrent MI.

- Spontaneous or provocable ischaemia.

- Cardiogenic shock or severe haemodynamic instability.

May be considered in

- Patients with LVEF ≤40%, in clinical heart failure, or having serious ventricular arrhythmias.

- Patients having documented clinical heart failure during the acute episode, even though subsequent evaluation shows preserved LV function (LVEF greater than 40%).

Routine PCI in the absence of spontaneous or provocable ischaemia may or may not improve LV function or survival.

Use of Adjunctive Technology to PCI

The use of the following techniques is likely to improve safety and outcomes of PCI and their use is optional.

- Intravascular Ultrasonography (IVUS).

- Coronary Flow Velocity and Coronary Vasodilatory Reserve.

- Coronary Artery Pressure and Fractional Flow Reserve

Non ST segment elevation myocardial infarction (NSTEMI)

Presentation of Unstable Angina

Rest Angina	Angina occurring at rest and prolonged, usually >20 minutes
New Onset angina	New-onset (within preceding 60 days) angina of at least CCS Class III severity.
Increasing Angina	Previously diagnosed angina that has become distinctly more frequent, longer in duration, or lower in threshold (i.e., increased by greater than or equal to CCS class I to at least CCS Class III severity)
Post MI Angina	Angina within 14 days of documented myocardial infarction

PCI may be Considered in

Patients with onset of symptoms in the preceding 12–24 hours, and one or more of the following:

1. Severe congestive heart failure.

2. Haemodynamic or electrical instability.

3. Evidence of persistent ischaemia.

4. Persistent ischaemia, haemodynamic or electrical instability upto 24 hours after the onset of MI when thrombolysis fails.

Contraindicated in

1. A noninfarct related artery at the time of primary PCI of the infarct-related artery in patients without haemodynamic compromise.

2. Asymptomatic patients more than 12 hours after onset of STEMI who are haemodynamically and electrically stable.

3. Centres and by operators who are not experienced.

Indications for PCI in STEMI either as primary choice or after initial thrombolysis

Emergency Inter-hospital transfer for PCI for STEMI

1. Fibrinolytic therapy is contraindicated or unsuccessful.

2. Cardiogenic shock ensues.

3. Anticipated delay in transportation is less than 60 min.

4. Symptoms have been present for more than 2–3 hours in thrombolytic eligible patients.

PCI is the Treatment of Choice in

1. Patients who present up to 12 hours of onset of symptoms and ongoing pain and/or haemodynamic instability.

2. Patients who develop shock within 36 hours of MI and are suitable for revascularization that can be performed within 18 hours of shock.

3. Persistent ischaemia, haemodynamic or electrical instability up to 12 hours after the onset of MI when thrombolysis fails (rescue PTCA for failed thrombolysis).

Signs and Symptoms of ACS

Features	High Likelihood *Any of the following:*	Low Likelihood *Absence of high likelihood features, but may have:*
History	Chest or left arm pain or discomfort as chief symptom reproducing prior documented angina. Known history of CAD including MI. Chest or left arm pain or discomfort as chief symptom. Age ≥40 years. Male sex. Diabetes mellitus. Family history of premature CAD (history of CAD in <55 yrs in male or <65 yrs in female, first degree relative).	Probable ischaemic symptoms in absence of any of the high likelihood characteristics. Recent cocaine use.
Examination	Transient mitral regurgitation, hypotension, diaphoresis, pulmonary oedema or rales. Extracardiac vascular disease.	Chest discomfort reproduced by palpation.
ECG	New, or presumably new, transient ST- segment deviation (≥0.05 mV) or T-wave inversion (≥0.2 mV) with symptoms. Fixed Q waves abnormal ST segment or T waves not documented to be new.	T-wave flattening or inversion in leads with dominant R waves. Normal ECG.
Cardiac markers	Elevated cardiac TnI, TnT, or CK-MB.	Normal.

Clinical Classification of Chest Pain

Typical Angina (High likelihood of underlying CAD)

- Substernal chest discomfort with a characteristic quality and duration,
- Provoked by exertion or emotional stress, and
- Relieved by rest or nitrate.

Atypical Angina

- Meets two of the above characteristics.

Non Cardiac Chest Pain

- Meets one or none of the typical anginal characteristics.

Angina Equivalents

- Dyspnoea on exertion, epigastric discomfort, jaw pain, ear ache.
- Provoked by emotional stress or exertion, relieved by rest or nitrate.

Features Not Characteristic of Myocardial Ischaemia

- Pleuritic pain (i.e. sharp or knife like pain brought on by respiratory moment or cough).
- Primary or sole location of discomfort in the middle or lower abdominal region.
- Pain that may be localized by the tip of one finger, particularly over left ventricular (LV) apex.
- Pain reproduced with movement or palpation of the chest wall or arms.
- Constant pain that lasts for many hours.
- Very brief episodes of pain that last a few seconds or less.
- Pain that radiates to the lower extremities.

PCI may be Considered in

Selected patients taking into consideration the age, the extent of the disease, length and complexity of the lesions, diabetes, the probability of completeness of revascularization, the ability to afford a second intervention if needed, etc.

1. Single or multivessel disease with involvement of proximal LAD.
2. Multivessel disease in diabetics.
3. Multivessel disease in patients with left ventricular dysfunction.
4. Left main disease and patient fit for CABGS.

PCI is Contraindicated in

1. Stenotic lesions <50% diameter stenosis.
2. Only a small area of myocardium at jeopardy.
3. Questionable symptoms with no objective evidence of ischaemia.
4. Patient has significant co-morbid conditions and outcome is likely be complicated.
5. Complex lesions that may have low success and more complications.

In Chronic Stable angina or In Asymptomatic patients with objectively demonstrable severe ischaemia or In patients with acute coronary syndrome (ACS) without STEMI

ACS: High Risk Group

1. Recurrent rest angina in spite of good medical therapy.

2. Features of haemodynamic or electrical instability.

3. Elevation of cardiac enzymes.

4. Known patients of CAD with prior coronary event, PCI or CABGS.

5. Diabetes Mellitus.

6. Significant dynamic ECG changes.

7. Post Infarct Angina.

   Early Invasive strategy is preferred.

Treatment of Choice for Patients with

1. Large or moderate area of myocardium at jeopardy and the lesion is suitable for PCI.

2. Patient with more than 50% LMCA disease, but is not a candidate for CABGS or has a protected LMCA.

3. Patient with restenosis and a repeat PCI is possible.

Involvement of a large area of myocardium would indicate that the area was jeopardized by lesions at proximal and mid LAD and LCX, RCA lesions upto the origin of PDA, Proximal segment of Ramus or Large OM or rarely a large diagonal or large PLV branches.

Investigations in ACS

Investigations	Comments
ECG	Initial ECG should be done and interpreted within 10 minutes of arrival. Subsequent frequency of ECG is based on the merit of the case. Comparison with previous ECGs (if available) aids in the decision making.
Biochemical Cardiac Markers	CPK, CPK-MB, Troponin T or I estimation on arrival. Repeat measurements after 6 to 8 hour interval may be required. Quantitative estimation of troponin (if available) predicts risk. Troponin T or I > 0.1 ng/ml depicts high risk.
Blood tests	Haemoglobin, haematocrit, fasting and post prandial blood glucose, lipid profile and renal function tests in all. Estimation of homocysteine, CRP, Lp(a) and thyroid function tests can be considered on an individual basis. Pro BNP if cause of breathlessness in uncertain.
Chest X-Ray	To assess the degree of pulmonary venous hypertension (PVH).
Echocardiography	Echo should be performed in all to assess LV function, regional wall motion abnormality and mechanical complications, and to rule out aortic stenosis, mitral valve prolapse and hypertrophic cardiomyopathy.
Stress Test (TMT)	Symptom limited TMT after the initial stabilization in patients undergoing a noninvasive management strategy in low risk ACS.
Stress Echocardiography or Stress perfusion imaging	Presence of resting ECG abnormalities like LVH, LBBB, IVCD, pre-excitation or digoxin use.
Pharmacological stress imaging (dobutamine or adenosine stress test)	Physical limitations due to arthritis, amputation, severe PVD, severe COPD or general debility.
CT Angiography	Low risk ACS where stress cannot be performed or is not desired.
Coronary Angiography	In all high risk patients.

ECG Changes in ACS/NSTEMI

ST segment changes (suggestive)

• $\geq$ 0.5 mm horizontal or down sloping ST depression.

T wave changes (suggestive)

• 2 mm symmetrical T wave inversion or very tall T waves.

Nonspecific ST and T wave changes (less suggestive)

• ST depression < 0.5 mm or T inversion < 2 mm, isoelectric T wave or asymmetric T inversion.

Pseudonormalization of ST-T wave (suggestive)

• A depressed ST segment at rest becomes isoelectric during anginal episode.

• An inverted T wave becomes upright during anginal episode.

Marker of established coronary artery disease

• Pathological Q waves ($\geq$ 0.04 sec duration or >25% of R wave), isolated Q wave in L III may be a normal finding.

Marker of severe coronary artery disease or LMCA disease

• ST depression $\geq$ 2 mm.

• ST depression in 3 or more leads.

• ST depression in precordial leads associated with ST elevation in aVR.

• ST depression associated with hypotension.

Glimpse into Indian data

Total number of centres	109
Total number of patients	42,123
Number of stents used	50,980
Percentage of DES	55.3%
Percentage, male	79.1%
In-hospital death	0.54%
Subacute thrombosis	0.9%
Number of primary PCI	2956 (7%)

In Patients with Mild Angina

• Patients with mild or no symptoms can be managed medically.

• They have a good prognosis with lower annual event rates.

• However, patients who undergo revascularization have better quality of life and need less number of medications.

• But, there is no survival advantage to these patients with interventions.

High Risk Situations for PCI

1. Ostial, bifurcation and other complex lesions.

2. Sole surviving artery and if contralateral artery is completely occluded.

3. Previous myocardial infarction with severe left ventricular dysfunction.

4. Multivessel disease.

5. Degenerated saphenous venous grafts.

6. Large area of myocardium at jeopardy including LMCA, LMCA equivalent, distal vessel supplying collaterals to other territory.

7. Preprocedure renal insufficiency.

Diabetes Mellitus and PCI

1. Diffuse Coronary Artery Disease.

2. Smaller Coronary Arteries.

3. Higher incidence of Dyslipidemia and Renal insufficiency.

4. Higher incidence of associated Peripheral & Cerebrovascular disease.

5. Higher rates of Restenosis in any revascularization procedure.

6. Higher mortality in any revascularization procedure.

Short-Term Risk of Death or Nonfatal MI in patients with UA

Features	High Risk *At least one of the following features must be present:*	Low Risk *No high risk feature, but may have any of the following features:*
History	Accelerating tempo of ischaemic symptoms in preceding 48 h. Prior MI, peripheral or cerebrovascular disease, or CABG, prior aspirin use. Prolonged, ongoing (>20 minutes) rest pain.	
Character of pain	Prolonged (>20 min) rest angina, now resolved with moderate or high likelihood of CAD.	Atypical or noncardiac chest pain.
Clinical Findings	Pulmonary oedema, most likely due to ischaemia. New or worsening MR murmur, S3, new/worsening rales, hypotension, bradycardia, tachycardia. Age $\geq$ 40 years.	Age < 40 years.
ECG	Angina at rest with transient ST-segment changes > 0.05 mV, Bundle-branch block (new or presumed to be new). Sustained ventricular tachycardia. T-wave inversions > 0.2 mV, pathological Q waves.	Normal or unchanged ECG during an episode of chest discomfort.
Cardiac markers	Elevated (e.g. TnT or TnI > 0.1 ng/mL).	Normal.

Indications for Admission for ACS

Any of the following

- Classical chest pain.

- Significant ECG changes.

- Haemodynamic instability (Hypotension/tachycardia bradycardia/ mitral regurgitation/LVS3/pulmonary rales).

- Electrical instability (Frequent VPCs/couplets/NSVT/VT/VF/atrial fibrillation or flutter).

- Elevated biomarkers (Troponins/CPK/CPK-MB/Myoglobin).

- Multiple risk factors of CAD (at least two of the following: Age ≥40 years, smoking, diabetes mellitus, family history of CAD, dyslipidaemia, hypertension).

Predictors of Restenosis after PCI

Clinical factors

- Diabetes mellitus.

- Unstable angina or non-STEMI.

- STEMI.

- Previous restenosis.

- Renal insufficiency.

Angiographic factors

- Proximal left anterior descending artery lesions.

- Long lesion length.

- Total occlusion.

- Small vessel diameter.

- Saphenous venous grafts.

Procedural factors

- High residual diameter stenosis.

- Smaller minimal lumen diameter.

- Smaller acute gain.

Guidelines for PCI

Recommendations for Different Hospital Categories

Category of Hospitals	Recommendations
Category I	1. Aspirin, Clopidogrel, LMWH, beta-blocker, nitrate, ACE inhibitor, statin 2. Cardiac Monitoring, serial ECG, biomarker estimation, Echo 3. Either early invasive or early conservative strategy
Category II	1. Aspirin, Clopidogrel, LMWH, beta-blocker, nitrate, ACE inhibitor, statin 2. Cardiac Monitoring, serial ECG, biomarker estimation, Echo 3. Patient with recurrent or persistent angina, positive biomarkers, haemodynamic or electrical instability should be transferred to category I hospital. Transfer should be done under ECG monitoring. The facilities for defibrillation and rescucitation should be available during the transport. 4. Patient who stabilizes or is at a low risk should be treated here. Further management depends on the results of stress test.
Category III	1. Aspirin, Clopidogrel, LMWH, beta-blocker, nitrate, ACE inhibitor, statin. 2. ECG should be interpreted preferably within 10 minutes. 3. High risk patients should be transferred to category I hospital. 4. Low risk patients can be managed and advised further elective evaluation after discharge at category II/I hospital.
Category IV	1. Aspirin, Clopidogrel, beta-blocker, nitrate, ACE inhibitor, statin. 2. Send patients for ECG to the nearest category III/II/I hospital. 3. Transfer the high risk patients to category II/I hospital.

Category I: Facilities with cardiac catheterization laboratory, interventional cardiology and cardiac surgical back up.

Category II: Medical centres with ICCU, trained staff, defibrillators, pacing facility and echocardiography.

Category III: ICU without adequate infrastructure & trained manpower.

Category IV: Peripheral health centers (ECG facility not always available).

Recommended Antithrombotic therapy in unstable angina/NSTEMI

Oral Antiplatelet Therapy

Tab. Aspirin	162-325 mg non enteric coated formulation to be chewed. If patient is not on aspirin then 75-325 mg daily to be given
	+
Tab. Clopidogrel	300-600 mg loading dose, then 75 mg per day.

Heparins

Inj. Heparin (UFH)	60-70 U/Kg (Maximum 5000 U) IV followed by 12-15 U/Kg/Hour Max (1000 U/H) titrated to aPTT 1.5-2.5 times control.
	OR
Inj. Enoxaparin (LMWH)	1 mg/Kg SC every 12 hours (Half of the initial dose i.e. 0.5 mg/kg should be given IV bolus and rest SC).
	OR
Inj. Dalteparin (LMWH)	120 IU/Kg SC 12 h [7500 units, SC, BD (Max.10,000 U)].
	OR
Inj. Nadroparin	86 anti Xa IV/Kg IV bolus. 86 anti Xa IV/Kg SC, BD.

PCI in patients with LMWH

If the patient had received at least 2 doses of enoxaparin and last dose was given at less than 8 hours: No heparin or LMWH during PCI.

If enoxaparin was given at >8 hours but ≤12 hours: Enoxaparin 0.5 mg IV during PCI.

If enoxaparin was given >12 hours before: Heparin or enoxaparin as standard practice.

Differences Between Indian and Western Patient Profile

• Earlier onset of disease.

• Higher prevalence of Diabetes and Metabolic Syndrome.

• Higher incidence of multiple plaques and diffuse CAD.

• Higher incidence of nondialysis dependent renal insufficiency.

• CABG is cheaper than multiple (drug coated) stents.

• Many of the patients cannot afford a repeat intervention.

Classification of Recommendations

Treatment of choice or preferred treatment

Noncontroversial, or the majority recommend this procedure. Procedure is associated with better clinical outcomes.

Procedure may be considered or conducted in select patients

There is some conflict of opinion. Decisions have to be individualized after weighing the pros and cons of the procedure with the patient. A second opinion from another cardiologist may be preferred.

Contraindicated

The procedure is not indicated. It may be non-beneficial or may even cause some harm to the patient.

Interventional Strategies: Catheter Based and Surgical

Lead: Dr. BS Raju, Hyderabad

Dr. TS Kler, Delhi

Dr. R Panda, Mumbai

Dr. M Samuel, Chennai

Dr. DKS Sastry, Hyderabad

Dr. D Shetty, Bangalore

Dr. N Trehan, Delhi

Recommendations of Gp IIb/IIIa inhibitors in unstable angina/NSTEMI

Agent	Dose	Patient Subset
Eptifibatide (Integrillin[TM], Eptiflow[TM], Coromax[TM])	180 μg/kg IV, 2 doses 10 min apart followed by 2 μg/kg/min IV x 18–20 h	(i) As a part of conservative management in high risk patient. (ii) ACS undergoing PCI.
Tirofiban (Aggrastat[TM], Aggramed[TM], Aggribloc[TM])	0.4 μg/kg/min IV over 30 mins. 0.1 μg/kg/min IV for 48-72 h.	(i) As a part of conservative management in high risk patient. (ii) ACS undergoing PCI.
Abciximab (ReoPro[TM])	0.25 mg/kg IV followed by 0.125 μg/kg/min IV x 12 h	(i) Patients with ACS undergoing PCI.

Benefits of Antiplatelet and Antithrombin Inhibitors
(Time dependent risk factor reduction)

	<30 days	>30 days
Aspirin	35%	25%
Clopidogrel	20%	20%
Thrombin Inhibitors	20%	0%
Gp IIb/IIIa inhibitors	9%	0%

Noninvasive Risk Stratification

High risk (>3% annual mortality rate)

1. Severe resting LV dysfunction (LVEF >0.35).

2. High-risk treadmill score (Duke score ≤ -11).

3. Severe exercise LV dysfunction (exercise LVEF <0.35).

4. Stress induced large perfusion defect (particularly if anterior).

5. Stress-induced multiple perfusion defects of moderate size.

6. Large fixed perfusion defect with LV dilation or increased lung uptake (thallium-201).

7. Stress-induced moderate perfusion defect with LV dilation or increased lung uptake (thallium-201).

8. Echocardiographic wall motion abnormality (involving > 2 segments) developing at a low dose of dobutamine (≤10 mcg/Kg/min) or at a low heart rate (120 bpm).

9. Stress echocardiographic evidence of extensive ischaemia.

Intermediate risk (1-3% annual mortality rate)

1. Mild/moderate resting LV dysfunction (LVEF ≥ 0.35-0.49).

2. Intermediate-risk treadmill score (Duke Score >-11 to <5).

3. Stress induced moderate perfusion defect without LV dilation or increased lung intake (thallium-201).

4. Limited stress echocardiographic ischaemia with wall motion abnormality only at higher doses of dobutamine involving ≤ 2 segments.

Low risk (<1% annual mortality rate)

1. Low risk treadmill score (score ≥5)

2. Normal or small myocardial perfusion defect at rest or with stress.

3. Normal stress echocardiographic wall motion or no change of limited resting wall motion abnormalities during stress.

Goals	Intervention Recommendations
Goal HbA,C <6.5%	Treatment of other risk factors (e.g. physical activity, weight management, blood pressure, and cholesterol management).
Antiplatelet agents/ Anticoagulants	Start and continue indefinitely aspirin 75 to 162 mg/d if not contraindicated. Consider clopidogrel 75 mg/d or warfarin if aspirin is contraindicated. Manage warfarin to INR 2.5 to 3.5 in post-STEMI patients when clinically indicated or for those not able to take aspirin or clopidogrel.
Renin-angiotensin/ aldosterone system blockers	ACE inhibitors in all patients indefinitely; start early in stable high – risk patients (anterior MI, previous MI, Killip class > II [S3 gallop, rales, radiographic CHF], LVEF less than 0.40). Angiotensin receptor blockers in patients who are intolerant of ACE inhibitors and with either clinical or radiological signs of heart failure or LVEF < 0.40. Aldosterone blockade in patients without significant renal dysfunction § or hyperkalaemia[||] who are already receiving therapeutic doses of an ACE inhibitor, have an LVEF ≤ 0.40, and have either diabetes or heart failure.
Beta–Blockers	Start in all patients. Continue indefinitely. Observe usual contraindications.

STEMI = ST – elevation myocardial infarction; **TG** = triglycerides; **LDL-C** = low-density lipoprotein cholesterol; **HDL-C** = high-density lipoprotein cholesterol; **BMI** = body mass index; **INR** = international normalized ratio; **ACE** = angiotensin converting enzyme; **MI** = myocardial infarction; **CHF** = congestive heart failure; **LVEF** = left ventricular ejection fraction.

*   Non – HDL-C = total cholesterol minus HDL-C.

†   Treat to a goal of non-HDL-C substantially < 130 mg/dL.

‡   Dietary – supplement niacin must not be used as a substitute for prescription niacin, and over–the–counter niacin should be used only if approved and monitored by a physician.

§   Creatinine should be <2.5 mg/dL in men or < 2.0 mg/dL in women.

|| Potassium should be < 5.0 mEq/L.

Modified with permission from Smith *et al. Circulation* 2001;104:1577-1579.

Goals	Intervention Recommendations
Lipid management: (TG 200 mg/dL or greater)	If TGs > 150 mg/dL or HDL–C is <40 mg/dL: ❖ Emphasize weight management and physical activity. Advise smoking cessation
Primary goal: Non – HDL-C substantially 130 mg/dL	If TG is 200–499 mg/dL: ❖ After LDL–C– lowering therapy,[†] consider adding fibrate< or niacin[‡] If TG>500 mg/dL: ❖ Consider fibrate or niacin [‡] before LDL-C-lowering therapy.[†] ❖ Consider omega–3 fatty acids as adjunct for high TG.
Physical activity:	Assess risk, preferably with exercise test to guide prescription.
Minimum goal 30 minutes, 3 to 4 days per week Optimal daily	Encourage minimum of 30–60 minutes of activity, preferably but at least 3 or 4 times weekly (walking, jogging, cycling, or other aerobic activity) supplemented by an increase in daily lifestyle activities (e.g. walking breaks at work, gardening, household work). Cardiac rehabilitation programs are recommended for patients with STEMI, particularly those with multiple modifiable risk factors and/or those moderate – to high – risk patients in whom supervised exercise training is warranted.
Weight management: **Goal** BMI 18.5-24.9 kg/m^2	Calculate BMI and measure waist circumference as part of evaluation. Monitor response of BMI and waist circumference to therapy. Start weight management and physical activity as appropriate. Desirable BMI range is 18.5–24.9 kg/m^2.
Waist circumference: Women: less than 35 in Men: less than 40 in	If waist circumference > 40 inches in men, initiate lifestyle changes and treatment strategies for metabolic syndrome.
Diabetes management:	Appropriate hypoglycemic therapy to achieve near – normal fasting plasma glucose, as indicated by HbA$_1$C.

Recommendations for early invasive strategy in ACS

• Recurrent angina/ischaemia at rest or with low level activities despite intensive anti-ischaemic therapy.
• Elevated TnT or TnI.
• CHF symptoms, S3 gallop, pulmonary oedema, worsening rales, or new or worsening mitral regurgitation.
• High-risk findings on noninvasive stress testing.
• Depressed LV systolic function (e.g. EF <0.40).
• Haemodynamic instability.
• Sustained ventricular tachycardia
• PCI within previous 6 months
• Prior CABG.

Recommendation of ACE inhibitors in unstable angina/NSTEMI

Indications

1) CHF.

2) Asymptomatic LV dysfunction (EF<0.40%).

3) Hypertension.

4) Diabetes Mellitus.

Agents

1) Ramipril 2.5–10 mg/day.

2) Perindopril 4–8 mg/day.

3) Enalapril 5–40 mg/day.

Recommendations for Lipid Lowering Therapy

The goal is to keep LDL cholesterol level <70 mg%. Statins in adequate doses cause 30–40% reduction in LDL cholesterol.

1. Atorvastatin 20–80 mg/day in patients with LDL ≥130 mg/dL.

2. Atorvastatin 20–80 mg/day in patients with LDL ≥100 mg/dL inspite of adequate dietary measures and exercise.

3. Alternatively Simvastatin 20–40 mg/day, Lovastatin 40 mg/day, Rosuvastatin 5–10 mg/day or Pravastatin 40 mg/day can be used.

The dosages can be uptitrated to achieve the goal.

Table 8: Secondary Prevention for Patients with STEMI

Goals	Intervention Recommendations
Smoking:	Assess tobacco use. Strongly encourage patient and family to stop smoking and to avoid second-hand smoke.
Goal	Provide counseling, pharmacological therapy (including nicotine replacement , complete cessation and bupropion), and formal smoking cessation programs as appropriate.
Blood pressure control:	If blood pressure is 120/80 mmHg or greater:
Goal	❖ Initiate lifestyle modification (weight control, physical activity, alcohol moderation, moderate sodium restriction, and emphasis on fruits, vegetables, and low-fat dairy products) in all patients.
If blood pressure is 140/90 mmHg or greater or 130/80 mmHg or greater for individuals with chronic kidney disease or diabetes :	
	❖ Add blood pressure reducing medications, emphasizing the use of beta blockers and inhibitors of the renin – angiotensin – aldosterone system
Lipid management: (TG < 200 mg/dL)	Start dietary therapy in all patients (<7% of total calories as saturated fat and < 200 mg/d cholesterol). Promote physical activity and weight management. Encourage increased consumption of omega –3 fatty acids.
Primary goal: LDL – C substantially < 100 mg/dL	Assess fasting lipid profile in all patients, preferably within 24 hours of STEMI. Add drug therapy according to the following guide.
	LDL–C ≤ 70 mg/dL (baseline or on treatment): ❖ Statins should be used to lower LDL–C. LDL – C > 100 mg/dL (baseline or on treatment): ❖ Intensify LDL– C – lowering therapy with drug treatment, giving preference to statins.

Indicators of High Risk

- Failed reperfusion.

- Mechanical complications.

- Development of shock.

- Moderate to severe LV dysfunction.

- Features of pulmonary congestion.

Acute ST segment elevation myocardial infarction (STEMI)

Suggested Lab Investigations for Patients with STEMI

- Serum cardiac markers – CPK, CPK – MB, semi quantitative Trop-T kits can be used
- CBC with platelet count
- INR
- aPTT
- Electrolytes, Magnesium
- BUN
- Creatinine
- Glucose
- Lipids

Molecular Biomarkers

Biomarker	Range of time to initial elevation	Mean time to peak elevation	Range
CK-MB	3– 12 hours	24 hours	48 –72 hours
CTnI	3– 12 hours	24 hours	5 – 10 d
CTnT	3– 12 hours	12 h - 2 days	5 – 14 d
(Infrequently used) Myoglobin	1– 4 hours	6 – 7 hours	24 hours

Predischarge Management / Risk Stratification Strategy
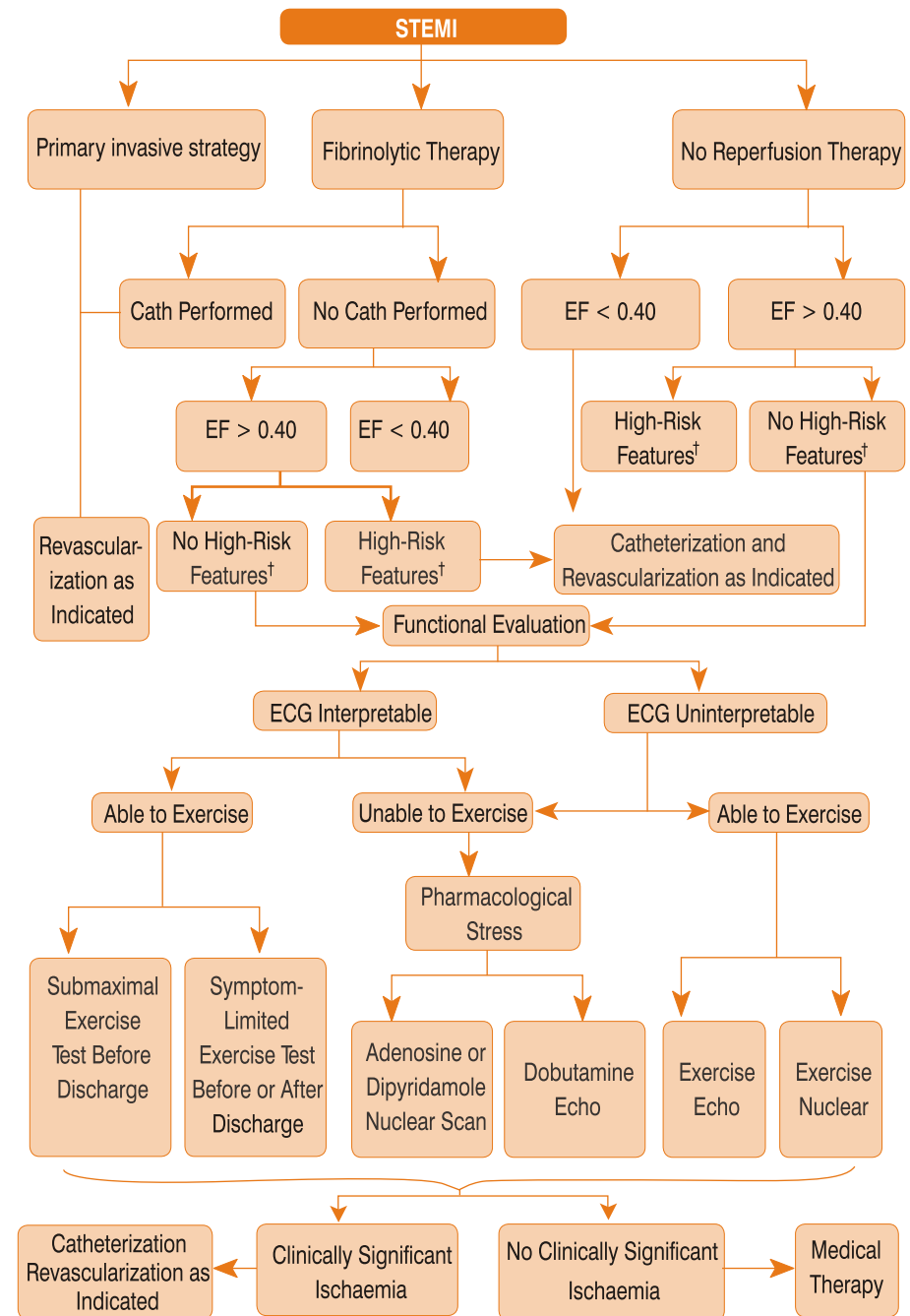
Indications for PCI After Fibrinolysis

i. Objective evidence of recurrent myocardial infarction.

ii. Moderate or severe spontaneous or provocable ischaemia.

iii. Cardiogenic shock or haemodynamic instability where anatomy is suitable.

iv. LVEF $\leq$ 0.40, CHF or serious ventricular arrhythmias.

v. Clinical heart failure during acute episode even though subsequent LVEF > 0.40 (preserved LV function).

vi. Routine PCI might be considered as part of an invasive strategy after fibrinolytic therapy.

Indicators of successful thrombolysis (reperfusion)

• Resolution of ST segment elevation by $\geq$50%.

• Resolution of ischaemic discomfort.

• Haemodynamic stability.

• Early peak of biomarkers. Additional interpretation of reperfusion can be made from biomarkers following fibrinolytic therapy. An early peak of CK-MB (12–18 hours) suggests reperfusion.

Diagnosis of Recurrent MI

Suspected recurrent MI after STEMI

Is biomarker elevated at time of event?

Biomarker elevated more than upper limit of normal

- Within 18 hours of STEMI → Recurrent ST elevation and at least one supporting criteria: chest pain, haemodynamic decompensation → OR → New MI diagnosed at autopsy

- More than 18 hours of STEMI → Biomarker re-elevation by atleast 50% and atleast one supporting criteria: chest pain, haemodynamic decompensation, ECG changes. → OR → New MI at autopsy

Less than upper limit of normal → Biomarker re-elevated and at least one supporting criteria: chest pain, ECG changes → OR → New MI at autopsy

Within 24 hours of PCI → Biomarker re-elevated CKMB more than 3 times ULN → OR → New Q waves → OR → New MI at autopsy

Within 24 hours of CABG → Biomarker re-elevated CKMB more than 10 times ULN → OR → Biomarker re-elevated CKMB 5 times ULN and new Q waves → OR → New MI at autopsy

Influence of Time to Treatment on In-Hospital Mortality

Vienna STEMI registry
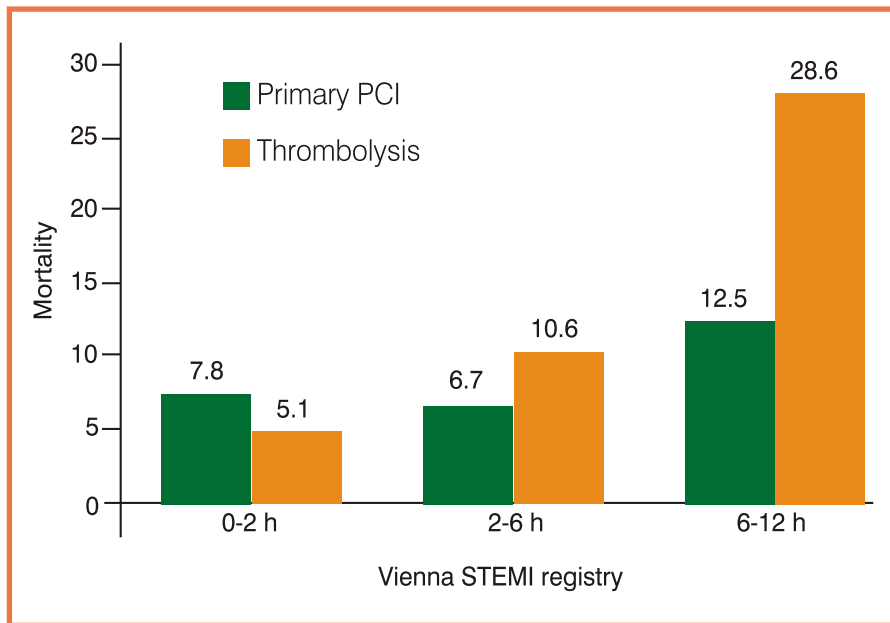
Biomarkers - Indicators for Reperfusion
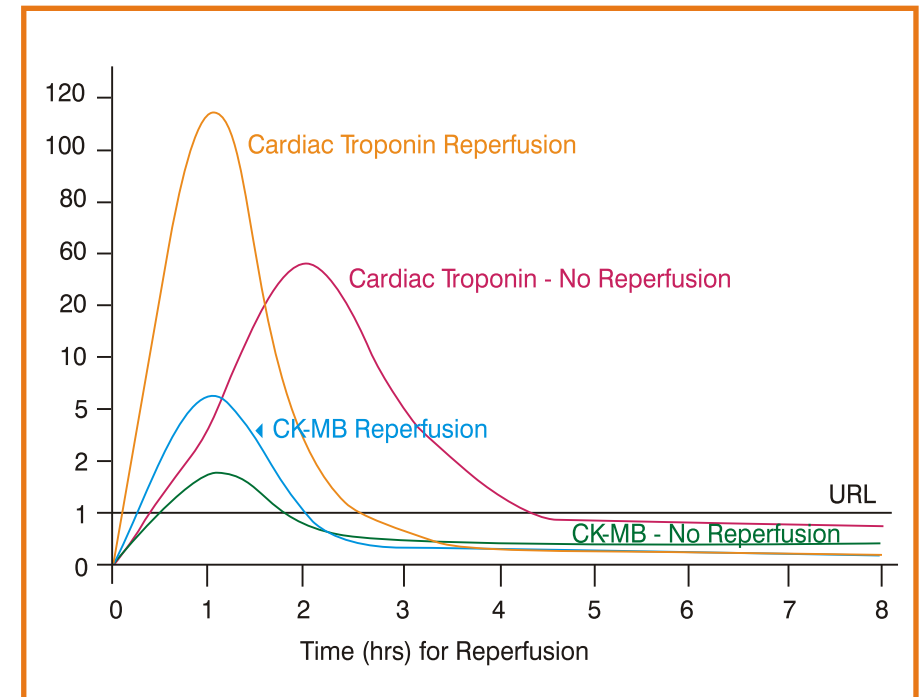
Indications of Coronary Angiography in STEMI

a.   In candidates for primary or rescue PCI.

b.   In patients with cardiogenic shock who are candidates for revascularization.

c.   In candidates with complication of myocardial infarction.

d.   In patients with persistent haemodynamic or electrical instability.

Commercially Available Fibrinolytic Agents

	Streptokinase	Alteplase	Reteplase	Tenecteplase tPA
Dose	1.5MU over 30–60 mins.	Up to 100 µg in 90 mins.	10U x 2 each over 2 mins.	30-50 µg based on weight
Bolus administration	No	No	Yes	Yes
Antigenicity	Yes	No	No	No
Allergic reactions	Yes	No	No	No
Systemic fibrinogen depletion	Marked	Mild	Moderate	Minimal
90 minute patency rates	50%	75%	75%	75%
TIMI grade III flow	32%	54%	60%	63%

Effects of Fibrinolytic Therapy on Mortality According to Admission ECG
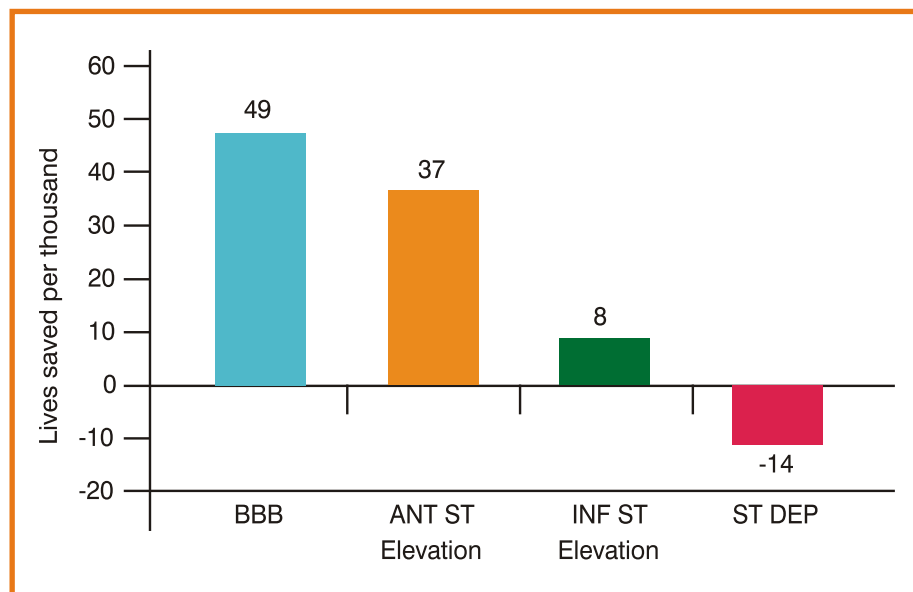
Hospital Categories and Management of MI
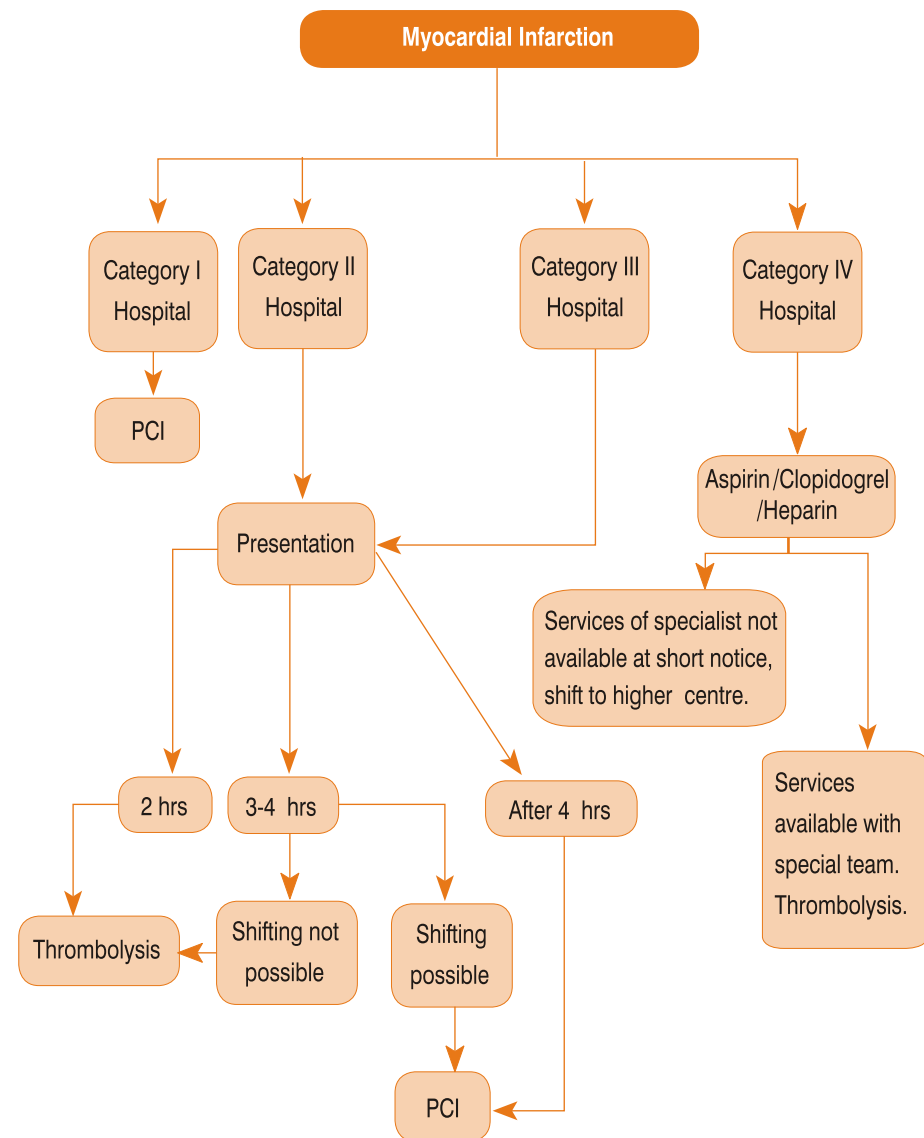
Suggested Management Algorithm for STEMI

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                    ┌─────────────────────────┐
                    │    Patient with STEMI   │
                    └─────────────────────────┘
              │                              │
              ▼                              ▼
    ┌──────────────┐              ┌──────────────────┐
    │ High         │              │ Non PCI Centre   │
    │ volume 1°    │              └──────────────────┘
    │ PCI Centre   │                │              │
    └──────────────┘                ▼              ▼
         │                ┌──────────────┐  ┌──────────────────┐
         │                │ Very early   │  │ Late presentation│
         │                │ presentation │  │ (> 2 hours)      │
         │                │ (≤ 2 hours)  │  └──────────────────┘
         │                └──────────────┘      │          │
         │                       │              ▼          ▼
         │                       ▼      ┌────────────┐ ┌────────────┐
         │              ┌──────────────┐│ Transfer   │ │ Transfer   │
         │              │ Onsite       ││ time       │ │ time       │
         │              │ Thrombolytic ││ ≤ 2 hours  │ │ > 2 hours  │
         │              │ therapy      │└────────────┘ └────────────┘
         │              └──────────────┘      │              │
         │              │              │      ▼              ▼
         ▼         ┌─────────────┐ ┌────────┐┌──────────┐┌────────────┐
    ┌──────────┐   │ Transfer to │ │ No     ││Transfer  ││ Facilitated│
    │ 1° PCI   │   │ high volume │ │transfer││to high   ││ PCI        │
    │ Centre   │   │ 1° PCI centre│ │if low  ││volume    │└────────────┘
    └──────────┘   │ if high risk│ │risk    ││1° PCI    │
                   │ features    │ └────────┘│centre    │
                   │ or failed   │           └──────────┘
                   │ reperfusion │
                   └─────────────┘
```
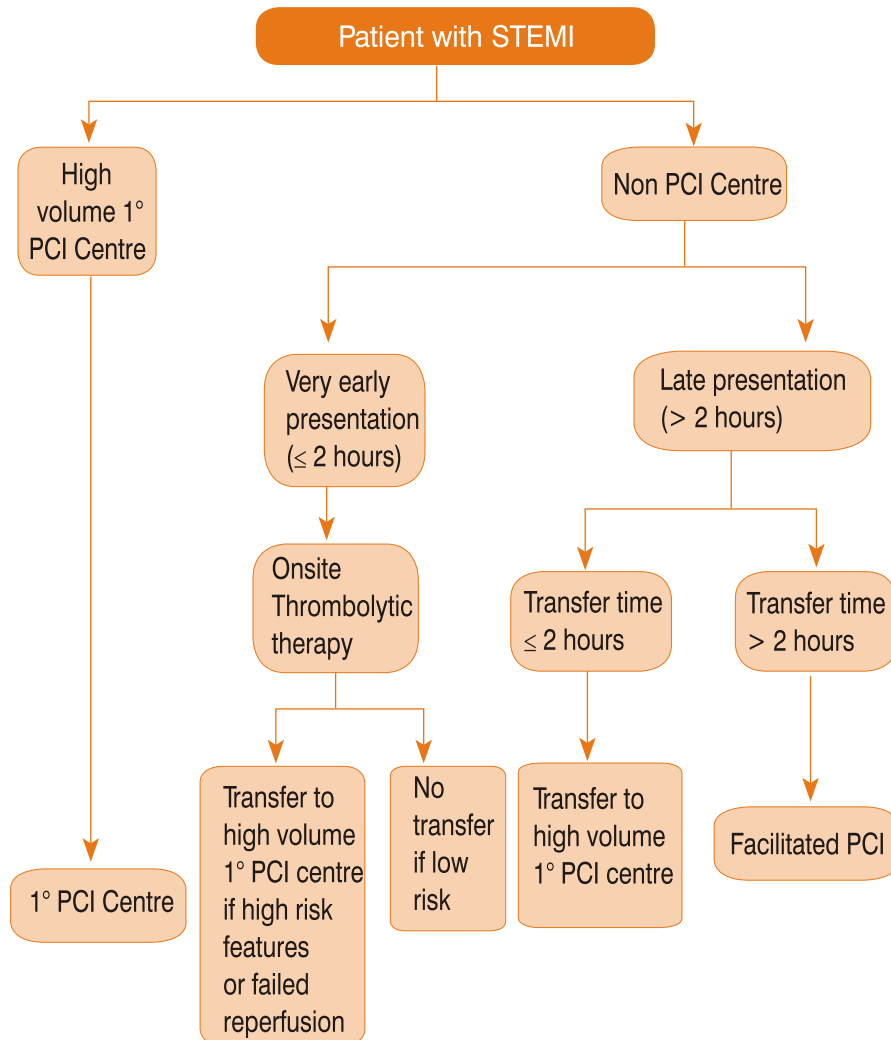
Contraindications to Fibrinolytic Therapy

ABSOLUTE:

a. Any prior ICH.

b. Known structural and vascular lesion (e.g. arteriovenous malformation).

c. Known malignant intracranial neoplasm.

d. Ischaemic stroke within 3 months except acute ischaemic stroke within 3 hours.

e. Suspected aortic dissection.

f. Active bleeding or bleeding diathesis (except menses).

g. Significant closed head or facial trauma within 3 months.

RELATIVE:

a) Chronic severe, poorly controlled hypertension.

b) Severe uncontrolled hypertension on presentation (systolic > 180 mmHg; diastolic > 110 mmHg).

c) History of prior ischaemic stroke greater than months, dementia or known intracranial pathology not covered in contraindications.

d) Traumatic or prolonged (> 10 minutes) CPR or major surgery (< 3 weeks).

e) Recent (within 2–4 weeks) internal bleeding.

f) Non-compressible vascular puncture.

g) For STK/anistreplase, prior exposure more than 5 days ago or prior allergic reaction to these agents.

h) Pregnancy.

i) Active peptic ulcer.

j) Current use of anticoagulation.

The higher the INR, higher the risk of bleeding.