Ethnic variations in CVD (Chest Pain)

RCGP

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“Cardiovascular disease has the same meaning for health care today as the epidemics of centuries had for medicine in earlier times: 50% of the population in developed countries die of cardiovascular disease” (Pál Kertai)

Someone has a heart attack every two minutes (British Heart Foundation)
Why is Cardiovascular Disease so Important?

- The UK’s biggest killer

Deaths by Cause - Men

- Coronary Heart Disease: 22%
- Other CVD: 9%
- Respiratory Disease: 12%
- Injuries and Poisoning: 4%
- Other Cancer: 19%
- Lung and Bowel Cancer: 10%
- Other: 16%

Deaths by Cause - Women

- Coronary Heart Disease: 16%
- Stroke: 13%
- Other CVD: 9%
- Respiratory Disease: 14%
- Injuries and Poisoning: 2%
- Lung, Breast, Other Cancer and Bowel Cancer: 11%
- Other: 22%

Source: Coronary Heart Disease Statistics (2005 edition), British Heart Foundation, as at 2003.
Public Health Significance of CVD

Leading cause of mortality in developed countries and a rising tendency in developing countries (disease of civilization)

A major impact on life expectancy

Significantly contributes to morbidity and death rates in the middle aged population: potential life years lost, common cause of premature death, labor force (economic costs), family life

Morbidity: nearly 30% of all disability cases

Contributes to deterioration of the quality of life
Types of Cardiovascular Disease

Coronary heart disease (CHD, ischemic heart disease, heart attack, myocardial infarction, angina pectoris)

Cerebrovascular disease (stroke, TIA, transient ischemic attack)

Hypertensive heart disease

Peripheral vascular disease

Heart failure

Rheumatic heart disease (streptococcal infection)

Congenital heart disease

Cardiomyopathies
PROPORTION OF MORTALITY IN DIFFERENT AGE-GROUPS (MEN)

- **1-24 yrs**
  - External: 61.5%
  - Others: 22.5%
  - Cancer: 11.4%
  - CVD: 4.6%

- **25-64 yrs**
  - External: 26.0%
  - Others: 26.9%
  - Cancer: 32.7%
  - CVD: 55.8%

- **>65 yrs**
  - External: 4.7%
  - Others: 14.9%
  - Cancer: 24.6%
PROPORTION OF MORTALITY IN DIFFERENT AGE-GROUPS (WOMEN)

- 1-24 yrs
  - External: 40.0%
  - Others: 35.0%
  - Cancer: 17.7%
  - CVD: 7.3%

- 25-64 yrs
  - External: 24.0%
  - Others: 36.5%
  - Cancer: 31.3%

- >65 yrs
  - External: 18.3%
  - Others: 12.2%
  - Cancer: 4.8%
  - CVD: 64.7%
SEX

Widespread idea: CVD is often thought to be a disease of middle-aged men.
Cardiovascular mortality (fatal cases) are more common among men. However, CVD affect nearly as many women as men, albeit at an older age.

Women: special case (WHO, 2004)
Higher risk in women than men (smoking, high triglyceride levels)
Higher prevalence of certain risk factors in women (diabetes mellitus, depression)
Gender-specific risk factors (risks for women only) (oral contraceptives, hormone replacement therapy, polycystic ovary syndrome)
In the US: increased cardiovascular disease deaths in African-American and South-Asian populations in comparison with Whites

Increased stroke risk in African-American, some Hispanic American, Chinese, and Japanese populations

Migration: Ni-Hon-San Study: Japanese living in Japan had the lowest rates of CHD and cholesterol levels, those living in Hawaii had intermediate rates for both, those living in San Francisco had the highest rates for both
World Trends

Developed countries: decreasing tendencies (e.g., USA: 30% between 1988-98, Sweden: 42%)

- **improvement of lifestyle factors**, for example, a decrease of smoking and a higher level of health consciousness in many developed countries
- **better diagnostic and therapeutic procedures** (e.g., bypass surgeries, hypertension screening, pharmacological treatment of hypertension and hypercholesterinaemia, access to health care)

Developing countries: increasing tendencies

- increasing longevity, urbanization, and western type lifestyle

*Estimates for Europe cover France, Germany, Italy, Spain, and the UK
Cardiovascular deaths in Europe (SDR, 2000)
SDR, diseases of circulatory system in Western Europe, 0-64 yrs, per 1000000

--- Austria
--- Denmark
--- Finland
--- France
--- Greece
--- Italy
--- Netherlands
--- Spain
--- Switzerland
--- United Kingdom
--- EU-15 average
Rates are Improving

- Death rates from coronary heart disease have been falling since 1970

SDR, diseases of circulatory system in Eastern Europe, 0-64 yrs, per 1000000

Croatia
Hungary
Romania
Russian Federation
Slovakia
EU-15 average (MSs prior 1.5.2004)
Adjusted for age, serum TC, current smoking status for each quartile
Heterogenous patterns of cardiovascular diseases among ethnic groups

- High rates of coronary heart disease (CHD) among South Asians but not Caribbeans
- High rates of hypertensive cardiovascular disease among Caribbeans
- The causes of ethnic differences in cardiovascular disease are unclear
- Very little known about when differences begin to emerge over the lifecourse
International Comparisons: Glucose tolerance distributions among west African-origin people

% diabetes (tested)

- Cameroon-rural
- Cameroon-urban 1.4
- Jamaica 3.0
- Manchester 6.4

Fasting glucose mmol/l

International & population studies suggest that environmental factors play the major role in explaining ethnic patterns in cardiovascular disease.

In the UK, large government surveys (prospective & cross-sectional) provide opportunities to track changes in risk.
Using the HSE’99 to track risk across generations

- Metabolic profiles of UK-born Black Caribbeans do not appear to be as protective against CHD as those of foreign-born Black Caribbeans

*Abbots, Harding, Cruickshank Atherosclerosis 2004;175:295-303*
The difference in death rates between South Asians (Pakistanis, Indians, Bangladeshis and Sri-Lankans) and the rest of the population is increasing.

From 1971 to 1991, the mortality rate for 20 – 69 year olds fell by:
- UK population: 29% in men and 17% in women
- South Asians: 20% in men and 7% in women
Ethnic Differences

Standardised mortality ratios for coronary heart disease by gender and country of birth, 1989/92, England and Wales

Source: Coronary Heart Disease Statistics (2005 edition), British Heart Foundation.
Ethnic Differences

• South Asians living in the UK have a higher premature death rate from CHD than average

• Men 46% higher

• Women 51% higher
"South Asian" - individuals who originate from the Indian Subcontinent or adjacent countries

- Account for 17% of the global populace
- There are an estimated 20 million diaspora from the South Asian Subcontinent- nearly 2 million of whom live in the United States

Image & Source from: www.southasianconcern.org
• Public health estimates indicate that India accounts for approximately 60% of the world's heart disease burden\textsuperscript{1}, despite having less than 20% of the world's population. Heart disease is the number one cause of mortality and a silent epidemic among Indians.

• India, particularly the city of Hyderabad in the state of Andhra Pradesh, is currently the diabetic capital of the world \textsuperscript{2}.

• When heart disease strikes Indians, it tends to do so at an \textit{earlier age} (almost 33% earlier) and with higher mortality rates than other demographics.

• Furthermore, 50% of all heart attacks in Indian men occur under 50 years of age and 25% of all heart attacks in Indian men occur under 40 years of age, a staggering figure \textsuperscript{(1, 3-5)}! Indian women have high mortality rates from cardiac disease as well.

• \textbf{South Asians: “At Risk” Special Population in Healthy People 2010}
Why South Asians?

- Demographic data indicate that the heart disease rate among South Asians is double that of the national averages of the western world.

- This may be attributed to an underlying genetic predisposition to metabolic syndrome, elevated lipoprotein A levels, hypertension, and cardiomyopathy (6-8).

- Also a shift towards increasing consumption of red meats, tobacco smoking, and higher stress in sedentary call-center workers in India.
• A well balanced, heart healthy diet as well as positive lifestyle changes such as exercise, stress reduction techniques, control of hypertension and diabetes, and quitting smoking may reduce the incidence and progression of heart disease.  

• Unlike many developed countries, there is a notable paucity of public health infrastructure and initiatives in India to raise awareness about this important issue. To date, few healthcare providers in India routinely screen South Asians for heart disease risk factors. We can do something about this!
Ask every patient with chest pain about these risk factors:

- Smoking
- Cholesterol
- Diabetes
- Hypertension
- Family History
Expanding Risk Factors

- Smoking
- Hypertension
- Diabetes Mellitus
- Dyslipidemia
  - Low HDL
  - Elevated LDL / TG
- Family History—event in first degree relative ≥55 years old
  - male
  - 65 years old
- Age-- ≥ 45 for male/55 for female
- Chronic Kidney Disease
- Lack of regular physical activity
- Obesity
- Lack of diet rich in fruit, veggies, fiber
# Classification of Risk Factors

<table>
<thead>
<tr>
<th>Major modifiable risk factors</th>
<th>Other modifiable risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>- High blood pressure</td>
<td>- Low socioeconomic status</td>
</tr>
<tr>
<td>- Abnormal blood lipids</td>
<td>- Mental ill health (depression)</td>
</tr>
<tr>
<td>- Tobacco use</td>
<td>- Psychosocial stress</td>
</tr>
<tr>
<td>- Physical inactivity</td>
<td>- Heavy alcohol use</td>
</tr>
<tr>
<td>- Obesity</td>
<td>- Use of certain medication</td>
</tr>
<tr>
<td>- Unhealthy diet</td>
<td>- Lipoprotein(a)</td>
</tr>
<tr>
<td>- Diabetes mellitus</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-modifiable risk factors</th>
<th>”Novel” risk factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Age</td>
<td>- Excess homocysteine in blood</td>
</tr>
<tr>
<td>- Heredity or family history</td>
<td>- Inflammatory markers (C-reactive protein)</td>
</tr>
<tr>
<td>- Gender</td>
<td>- Abnormal blood coagulation (elevated blood levels of fibrinogen)</td>
</tr>
<tr>
<td>- Ethnicity or race</td>
<td></td>
</tr>
</tbody>
</table>
# INTERHEART Results

<table>
<thead>
<tr>
<th>Potential Risk Factors</th>
<th>Other Groups</th>
<th>South Asians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated Apo B/Apo A-1</td>
<td>31.8%</td>
<td>43.8%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>7.2%</td>
<td>10.7%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>23.6%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Non-smokers</td>
<td>50.6%</td>
<td>59.2%</td>
</tr>
<tr>
<td>Non obese</td>
<td>66%</td>
<td>70.4%</td>
</tr>
<tr>
<td>Moderate exercise</td>
<td>21.6%</td>
<td>6.1%</td>
</tr>
<tr>
<td>Daily Fruits, Vegetables</td>
<td>45.2%</td>
<td>26.5%</td>
</tr>
<tr>
<td>&gt;=1 Alcohol serving/week</td>
<td>26.9%</td>
<td>10.7%</td>
</tr>
<tr>
<td>Psychosocial stress</td>
<td>18%</td>
<td>14%</td>
</tr>
</tbody>
</table>


Table Adapted from: Presentation: Mathur A, The High Risk of Coronary Heart Disease in South Asians. Online at:
INTERHEART: 9 Modifiable factors account for 90% of first-MI risk worldwide

N = 15,152 patients and 14,820 controls in 52 countries
PAR = population attributable risk, adjusted for all risk factors

Key Screening Measures

- Do you smoke?
- BP testing
- Blood cholesterol and lipid profile
- Fasting plasma glucose
- Body mass index (BMI)-ratio of height to weight (kg/m2)
  - Specific measures for truncal obesity
Tobacco

- Number one preventable risk, unfortunately rates of smoking are rising among South Asians.¹²
- Health benefits of quitting smoking begin immediately
  - Most effective is combined pharmacologic and behavioral strategies
- Governmental prevention programs including package health warning labels and graphics
Dietary Strategies

- Home cooked meals
  - Preferred versus restaurant and fast food
- Carbs
  - Recommend whole grains, barley, oats
  - Roti is healthier option versus processed white rice
- Proteins
  - Veg Options include Soy, Tofu, Paneer (but watch the fat!)
  - White meats preferred over red meats
- Fat: Prefer unsaturated fats like EPA/DHA & Alpha-Linoleic Acid
  - Nuts and fresh fish are excellent sources
  - Avoid saturated fats such as ghee, stick margarine, coconut oils
  - Don’t reuse cooking oil—this is unfortunately a common practice in India!
A Healthy Meal
Not so Healthy!
Simplified Lipid Goals

- Diet and exercise are key!
- Total cholesterol goal: <5.0
- LDL (bad cholesterol) goal: <3.0
- HDL (good cholesterol) goal:
  - >1.0 in men, >1.2 for women

Physical Activity

- Helps lower BP, Diabetes, raises good cholesterol (HDL), manages stress, improves bone health, helps control weight
- 30 minutes of moderate activity most days of week
• Most Indians with CAD are actually within the *normal* weight range!
• Age related waist circumference may be a more specific measure $^{13}$.
• Nevertheless, Obesity is a major risk factor for CAD, elevated BP, high cholesterol, DM and a multitude of other health problems!
• Rapidly rising obesity rates within the West among all demographics.
Limitations of BMI!

Obesity, Metabolic Syndrome, Type 2 Diabetes and Cardiovascular Disease

- Obesity
- Metabolic syndrome
- Insulin resistance
- Diabetes

Risk:
- 2× Risk
- 4× Risk

Cardiovascular disease

Abdominal Adiposity: The Critical Adipose Depot

Is this where you measure?

M. Davidson, MD.
Why is Coronary Heart Disease so Common in South Asians?
Excess Exposure to Risk Factors

- Low HDL
- Elevated triglycerides
- Diabetes
- Lack of aerobic exercise
- Obesity
- Smoking
  - More common in men
  - Less common in all South Asian women
Greater Susceptibility

• Not been systematically studied

• Genetic differences

• Mismatch between fetal/early life metabolism and that in middle age

• Rapid change in some risk factors
Specific Risk Factors

- As yet unidentified
- Ghee and other cooking oils
- Salt
- Racism
- Insulin resistance
- Specific lipid abnormalities
Competing Causes

• Fewer competing causes

• Fewer cancer deaths
Odds of improvement in angina in south Asians compared with white patients within whole study population and by management strategy.

Numbers (%) with improved angina

<table>
<thead>
<tr>
<th></th>
<th>White</th>
<th>South Asian</th>
<th>Odds ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>910/1508</td>
<td>86/196</td>
<td>0.56 (0.41, 0.76)*</td>
</tr>
<tr>
<td>All</td>
<td>910/1508</td>
<td>86/196</td>
<td>0.48 (0.29, 0.81)**</td>
</tr>
<tr>
<td>Medical</td>
<td>370/699</td>
<td>42/97</td>
<td>0.87 (0.48, 1.57)**</td>
</tr>
<tr>
<td>PCI</td>
<td>164/279</td>
<td>12/34</td>
<td>0.19 (0.06, 0.56)**</td>
</tr>
<tr>
<td>CABG</td>
<td>370/530</td>
<td>32/65</td>
<td>0.36 (0.17, 0.74)**</td>
</tr>
</tbody>
</table>

*Age adjusted
**Adjusted for age, diabetes, hypertension, the number of diseased vessels, total cholesterol, left-ventricular function and social class

Inflammation and thrombosis drive the disease

The Problems

- Atheroma is not a linear process of gradual cholesterol deposition

It is more like a roller coaster
Pathogenesis of CAD

Image from: www.nhlbi.nih.gov/health/health-topics/topics/heartattack
Inflammation + Thrombosis = Coronary Disease = CHEST PAIN

- Stable angina – chest pain on exertion
- Acute coronary syndromes
  - Unstable angina / NSTEMI
    » worsening chest pain or rest pain
  - Acute myocardial infarction – Heart attack
Between 20 to 40% of people will experience chest pain or discomfort at some point resulting in:

~ 1% of primary care consultations
~ 5% of emergency department attendance
~ 40% of emergency hospital admissions

Not all coronary disease

Getting the diagnosis and risk stratification right are vital to improve outcomes and maintain patient safety, in whatever part of the NHS the patient presents.
Stable Angina

Acute Coronary Syndromes
Stable Angina
‘Chest pain of recent onset’
NICE guidance 95
March 2010
Features of stable angina

- Constricting discomfort in the front of the chest, neck, shoulders, jaw or arms
- Precipitated by physical exertion
- Relieved by rest or GTN in about 5 minutes

• People with –
  • **Non-anginal** chest pain have one or none of these features
  • **Atypical angina**: two features
  • **Typical angina**: all three features
Exclude a diagnosis of stable angina if the pain is NON-ANGINAL

- Unless clinical suspicion is raised based on other aspects of the history and risk factors

Other features which make stable angina UNLIKELY:
- continuous or very prolonged and/or
- unrelated to activity and/or
- brought on by breathing in and/or
- associated with symptoms such as dizziness, palpitations, tingling or difficulty swallowing

Consider causes of chest pain other than angina (such as gastrointestinal or musculoskeletal pain)
<table>
<thead>
<tr>
<th>Stable angina is more likely</th>
<th>Stable angina is less likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>increasing age</td>
<td>continuous or very prolonged pain</td>
</tr>
<tr>
<td>male</td>
<td>unrelated to activity</td>
</tr>
<tr>
<td>cardiovascular risk factors</td>
<td>brought on by breathing in</td>
</tr>
<tr>
<td>a history of established CAD (e.g. previous MI, coronary revascularisation)</td>
<td>associated with dizziness, palpitations, tingling or difficulty swallowing.</td>
</tr>
</tbody>
</table>
Questions and Answers

• Where is the pain? Central- in the middle
• What type of pain is it? Tight, heavy, pressing
• Does it go anywhere? Radiates to neck, back teeth and jaw, arms
• Does it happen when you walk/ run? Yes if “angina”
• Do you feel sweaty or breathless? Dyspnoea and sweating suggest cardiac pain
• Does it happen when you are doing nothing? Non cardiac pain OR “unstable” coronary disease
Remember other conditions

- Pulmonary embolus
- Dyspepsia/ulcer
- Musculoskeletal
- Pericarditis
- Pleurisy
People with risk factors are more likely to have coronary disease

- Smoking
- Cholesterol
- Diabetes
- Hypertension
- Family History

Ask every patient with chest pain about these risk factors
Examination

• You may find nothing
  – Ischaemic hearts don’t make noises or show on the skin

• Remember the risk factors
  – Hypertension
  – Smoking- tobacco stains
  – Signs of high lipids
ACS or stable angina? Possible ACS if….

- Pain in the chest and/or other areas > 15 mins
- Chest pain with
  - nausea and vomiting,
  - marked sweating or breathlessness
  - with haemodynamic instability
- New onset chest pain, or abrupt deterioration in stable angina, with recurrent pain occurring
- frequently with little or no exertion and often lasting longer than 15 minutes.
Investigation of Chest Pain

- Resting ECG
- Exercise tolerance test
- Coronary CT
- Non invasive functional testing
- Coronary angiogram
The Electrocardiogram (ECG)

This the isoelectric line – like zero on an ECG
The Electrocardiogram (ECG)

- **Normal**
  - ST segment on the line

- **Good News**
  - ST depression = ischaemia/angina

- **BAD NEWS**
  - ST elevation = Heart Attack

- **REALLY BAD NEWS**
  - Isoelectric line
Exercise Stress Test

Exercise reveals a lack of blood supply-
Chest pain/tightness and ECG changes
Does exercise treadmill testing have a role?

• ETT should NOT be used in people without KNOWN coronary artery disease to diagnose or exclude stable angina

• ETT can be used to assess chest pain in patients with a history of coronary artery disease
Non invasive functional imaging

- Radioisotope Myocardial perfusion scanning
- Stress echocardiography
- First-pass contrast-enhanced magnetic resonance (MR) perfusion
- MR imaging for stress-induced wall motion abnormalities.

Do not use:
- Exercise ECG to diagnose or exclude stable
Myocardial Perfusion Scanning

- **Nuclear test** – iv injection of a radioisotope (thallium or technecium)
- Use a gamma camera to detect the radioisotope
- Compare rest and stress
- Stress = Drugs or exercise
- Very helpful for those who cannot exercise or have an abnormal resting ECG
More isotope gets to normal areas then those supplied by narrow vessels or blocked vessels

Normal Scan

Stress

Rest

Scan showing ischaemia
Lack of blood supply

Stress

Rest
Stress Echocardiogram

• An ultrasound movie of the heart
• Before and during chemically simulated exercise
• Dobutamine infusion
Clinical Indications for CMR

<table>
<thead>
<tr>
<th>Indication</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assessment of global ventricular function</td>
<td>I</td>
</tr>
<tr>
<td>(left and right)</td>
<td></td>
</tr>
<tr>
<td>2. Detection of coronary artery disease</td>
<td>II</td>
</tr>
<tr>
<td>Regional left ventricular function at rest</td>
<td></td>
</tr>
<tr>
<td>and during dobutamine stress</td>
<td></td>
</tr>
<tr>
<td>Assessment of myocardial perfusion</td>
<td>II</td>
</tr>
<tr>
<td>Coronary MRA (CAD)</td>
<td>III</td>
</tr>
<tr>
<td>Coronary MRA (anomalies)</td>
<td>I</td>
</tr>
<tr>
<td>Coronary MRA of bypass graft patency</td>
<td>II</td>
</tr>
<tr>
<td>MR flow measurements in the coronary arteries</td>
<td>Inv</td>
</tr>
<tr>
<td>Arterial wall imaging</td>
<td>Inv</td>
</tr>
<tr>
<td>3. Acute and chronic myocardial infarction</td>
<td></td>
</tr>
<tr>
<td>Detection and assessment</td>
<td>I</td>
</tr>
<tr>
<td>Myocardial viability</td>
<td>I</td>
</tr>
<tr>
<td>Ventricular septal defect</td>
<td>III</td>
</tr>
<tr>
<td>Mitral regurgitation (acute MI)</td>
<td>III</td>
</tr>
<tr>
<td>Ventricular thrombus</td>
<td>II</td>
</tr>
<tr>
<td>Acute coronary syndromes</td>
<td>Inv</td>
</tr>
</tbody>
</table>

Class I = provides clinically relevant information and is usually appropriate; may be used as first line imaging technique; usually supported by substantial literature.

Class II = provides clinically relevant information and is frequently useful; other techniques may provide similar information; supported by limited literature.

Class III = provides clinically relevant information but is infrequently used because information from other imaging techniques is usually adequate.

Class Inv = potentially useful, but still investigational

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How good are the tests?

- Resting ECG
- Exercise test
- CT Calcium score
- Stress echo
- Perfusion scan
- Angiogram
HOW WILL THEY BE ASSESSED?

• Depends on risk assessment
  (NICE guidance)

• includes clinical examination and
• ECG findings
## Likelihood of coronary artery disease

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Non-anginal chest pain</th>
<th>Atypical angina</th>
<th>Typical angina</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men Lo</td>
<td>Hi</td>
<td>Women Lo</td>
</tr>
<tr>
<td>35</td>
<td>3</td>
<td>35</td>
<td>1</td>
</tr>
<tr>
<td>45</td>
<td>9</td>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>55</td>
<td>23</td>
<td>59</td>
<td>4</td>
</tr>
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<td>65</td>
<td>49</td>
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</table>

For men older than 70 with atypical or typical symptoms, assume an estimate > 90%.
For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.

Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).
Lo = Low risk = none of these three.

NICE clinical guideline CG95 Chest pain of recent onset
Features of stable angina

– Constricting discomfort in the front of the chest, neck, shoulders, jaw or arms
– Precipitated by physical exertion
– Relieved by rest or GTN in about 5 minutes

• People with –
  • Non-anginal chest pain have one or none of these features
  • Atypical angina: two features
  • Typical angina: all three features
Patient 1

- 55 year old postman
- Tightness across chest on walking, relieved by rest
- Non-smoker
- No risk factors
### Table 1: Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex, and risk factors

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For men older than 70 with atypical or typical symptoms, assume an estimate > 90%.
For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.

Values are per cent of people at each mid-decade age with significant coronary artery disease (CAD). Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre). Lo = Low risk = none of these three.
The shaded area represents people with symptoms of non-anginal chest pain, who would not be investigated for stable angina routinely.

**Note:** These results are likely to overestimate CAD in primary care populations. If there are resting ECG ST-T changes or Q waves, the likelihood of CAD is higher in each cell of the table.
Patient 2

- 35 year old female office worker
- Aching in jaw and throat whilst sitting at her desk, lasts an hour. Better if she relaxes. Unrelated to exercise.

- Diabetic
- Smoker
**Table 1** Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex and risk factors

<table>
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For men older than 70 with atypical or typical symptoms, assume an estimate > 90%.
For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.

Values are per cent of people at each mid-decade age with significant coronary artery disease (CAD).
Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).
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The shaded area represents people with symptoms of non-anginal chest pain, who would not be investigated for stable angina routinely.

**Note:** These results are likely to overestimate CAD in primary care populations. If there are resting ECG ST-T changes or Q waves, the likelihood of CAD is higher in each cell of the table.
### Likelihood of coronary artery disease < 9%

#### Table 1 Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex and risk factors

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<td></td>
<td>Men</td>
<td>Lo</td>
<td>Hi</td>
</tr>
<tr>
<td>30</td>
<td>88</td>
<td>10</td>
<td>78</td>
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<td>51</td>
<td>92</td>
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<td>80</td>
<td>95</td>
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**Hi** = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).
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NICE clinical guideline CG95 Chest pain of recent onset
<table>
<thead>
<tr>
<th>Estimated likelihood of CAD</th>
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<th>Estimated likelihood of CAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>10–29%</td>
<td>30–60%</td>
<td>61–90%</td>
</tr>
<tr>
<td>Offer CT calcium scoring</td>
<td>Offer non-invasive functional imaging</td>
<td>Offer invasive coronary angiography if appropriate</td>
</tr>
<tr>
<td>If CT calcium score is:</td>
<td>If reversible myocardial ischaemia uncertain, offer invasive coronary angiography</td>
<td>Offer non-invasive functional imaging if invasive coronary angiography not appropriate</td>
</tr>
<tr>
<td>■ zero, investigate other causes of chest pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ 1–400, offer 64-slice (or above) CT coronary angiography</td>
<td></td>
<td></td>
</tr>
<tr>
<td>■ &gt;400, follow pathway for 61–90% CAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If significant CAD uncertain, offer non-invasive functional imaging</td>
<td></td>
<td>If significant CAD uncertain, offer non-invasive functional imaging</td>
</tr>
</tbody>
</table>
Consider coronary angiography for 61-90% risk group

Take into account the person’s:

- preferences
- comorbidities
- risk from the procedure
- risk from radiation exposure
Consider coronary angiography for 61-90% risk group

Table 1 Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex and risk factors

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<td>3 35 1 19</td>
<td>8 59 2 39</td>
<td>30 88 10 78</td>
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<tr>
<td>45</td>
<td>9 47 2 22</td>
<td>21 70 5 43</td>
<td>51 92 20 79</td>
</tr>
<tr>
<td>55</td>
<td>23 59 4 25</td>
<td>45 79 10 47</td>
<td>80 95 38 82</td>
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<tr>
<td>65</td>
<td>49 69 9 29</td>
<td>71 86 20 51</td>
<td>92 97 56 84</td>
</tr>
</tbody>
</table>

For men older than 70 with atypical or typical symptoms, assume an estimate > 90%. For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.

Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre)
Lo = Low risk = none of these three

Men >70 with atypical or typical symptoms assume risk >90%
Women >70 assume risk 61-90% (high risk and typical risk>90%)

NICE clinical guideline CG95 Chest pain of recent onset
Non-invasive functional imaging for 30-60% risk group

- Nuclear perfusion scan
- Stress echocardiography
- Cardiac MRI perfusion scan

Take into account the person’s:
- preferences
- comorbidities
- risk from the procedure
- risk from radiation exposure
Non-invasive functional imaging for 30-60% risk group

Table 1 Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex and risk factors²

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Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).
Lo = Low risk = none of these three.

NICE clinical guideline CG95 Chest pain of recent onset
CT calcium scoring for 10-29% risk group

CT scan to detect calcium in the heart an indirect measure of atheroma - screening

What does the test involve?
• lying flat, ECG electrodes attached, breath hold 10 seconds, scan takes 5 min

Are there any risks?
• effective X ray dose approx equal to background radiation over 8 months
Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).
Lo = Low risk = none of these three.

NICE clinical guideline CG95 Chest pain of recent onset
CT calcium scoring for 10-29% risk group

• If score is zero – investigate other causes of chest pain

• If score is 1–400: offer 64-slice CT angiography (non invasive, anatomical test)

• If score is > 400 consider coronary angiography
CT calcium scoring

- Higher sensitivity and specificity than ETT therefore fewer referred on for further tests
- Effective screening tool in this low-risk group
- With CT calcium scoring as ‘gatekeeper’ CT angio is cost effective non invasive test
Summary

• Decide whether pain is non-anginal, typical or atypical angina

• Assess risk factors and ECG

• Calculate risk (NICE) / RACP referral form and decide whether to refer

• Treat risk factors

• Use ETT only in patients with known CAD
### Summary

#### Table 1 Percentage of people estimated to have coronary artery disease according to typicality of symptoms, age, sex and risk factors

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For men older than 70 with atypical or typical symptoms, assume an estimate > 90%. For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.

- **10-29%**  CT angiography
- **30-60%**  Functional Imaging
- **61-90%**  Coronary Angiography

NICE clinical guideline CG95 Chest pain of recent onset
Unlikely CAD 10-29%

- Offer CT calcium scoring
  - If score is 0: investigate other causes of chest pain
  - If score is 1–400: offer 64-slice (or above) CT coronary angiography
  - If score is > 400: follow pathway for 61–90% CAD (page 14)

Intermediate CAD risk 30-60%

- Offer non-invasive functional imaging (box 8)
  - Reversible myocardial ischaemia?
    - Yes: treat as stable angina
    - No: investiagte other causes of chest pain
    - Uncertain: offer invasive coronary angiography

Likely CAD 61-90% = invasive coronary angiography
Who to refer

• Exclude a diagnosis of stable angina if the pain is non-anginal

• If the estimated likelihood of CAD is <10%, first consider causes of chest pain other than angina

• If the estimated likelihood of CAD is >10%, refer to the Rapid Access Chest Pain Clinic

• NB Refer all over 70’s with atypical/typical angina
Acute Coronary Syndromes
Classification of acute coronary syndromes

Unstable chest pain

Acute coronary syndromes

STEMI

Troponin +ve

NSTEACS

Troponin -ve

NSTEMI

Unstable angina
Acute Coronary Syndromes

- Unstable Angina
- Non-ST-Segment Elevation MI (NSTEMI)
- ST-Segment Elevation MI (STEMI)

Similar pathophysiology
Similar presentation and early management rules

NSTEMI requires evaluation for acute reperfusion intervention
Typical rise and gradual fall of biochemical markers of myocardial necrosis

With at least one of the following
1. Ischaemic symptoms
2. Development of Q waves on the ECG
3. ECG changes indicative of ischaemia
4. Imaging evidence of new loss of viable myocardium or new regional wall motion abnormalities
Diagnosis of Unstable Angina

- **Patients with typical angina - An episode of angina**
  - Increased in severity or duration
  - Has onset at rest or at a low level of exertion

- **Patients not known to have typical angina**
  - First episode with usual activity or at rest within the previous two weeks
  - Prolonged pain at rest
NICE Guidelines (CG95)

Referral to hospital

ACS suspected?

Yes

- Start management immediately
- Do not delay transfer to hospital

No

Consider other causes of chest pain, including potentially life-threatening ones

Current chest pain or
Recent ACS and further chest pain develops

No current chest pain

Chest pain in the last 12 hours

- Resting 12-lead ECG abnormal or unavailable
  - Refer to hospital for assessment as an emergency (page 8)

Chest pain 12–72 hours ago

- Resting 12-lead ECG normal
  - No reasons for emergency referral

Chest pain more than 72 hours ago

- No complications

Signs of complications e.g. pulmonary oedema

Decide if referral should be:
- as an emergency
- for urgent same-day assessment (page 8)

Carry out an assessment (page 8). Decide if referral is:
- necessary
- urgent

NICE clinical guideline 95 Quick reference guide 7
Suspected ACS- start management immediately
Do not delay transfer to hospital

NICE clinical guideline CG95 Chest pain of recent onset
NSTE ACS
Overview

• NSTEACS
• Natural history
• Risk stratification
• Treatment
Spectrum of ACS

- Admission
- Working diagnosis
- ECG
- Bio-chemistry
- Diagnosis

Summary:
- Acute Coronary Syndrome
  - Chest Pain
  - Persistent ST-elevation
  - ST/T - abnormalities
  - Normal or undetermined ECG
  - Troponin rise/fall
  - Troponin normal

Decision:
- STEMI
- NSTEMI
- Unstable Angina
Epidemiology and natural history

- NSTE-ACS is more frequent than STE-ACS
- Annual incidence: 3 per 1000
- In-hospital mortality < STE-ACS (4% Vs 7%)
- 6 month mortality similar (~12-13%)
- Long-term mortality >STE-ACS
Risk stratification

http://www.outcomes.umassmed.org/grace/
The GRACE score

- an online calculator is available at [http://www.outcomes.umassmed.org/grace/](http://www.outcomes.umassmed.org/grace/)
- Age, Heart rate, SBP, creatinine,
- Killip class of heart failure
- ST segment deviation
- Cardiac arrest on admission
- Elevated cardiac enzymes
- Outcome is predicted death at 6 months
# Risk assessment

<table>
<thead>
<tr>
<th>Predicted 6-month mortality</th>
<th>Risk of future adverse cardiovascular events</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5% or below</td>
<td>Lowest</td>
</tr>
<tr>
<td>&gt; 1.5 to 3.0%</td>
<td>Low</td>
</tr>
<tr>
<td>&gt; 3.0 to 6.0%</td>
<td>Intermediate</td>
</tr>
<tr>
<td>&gt; 6.0 to 9.0%</td>
<td>High</td>
</tr>
<tr>
<td>over 9.0%</td>
<td>Highest</td>
</tr>
</tbody>
</table>

Risk categories derived from Myocardial Ischaemia National Audit Project (MINAP) database
Greater risk groups

- **Intermediate risk** (> 3.0–6.0%)
  - Offer a single 300-mg loading dose of clopidogrel and continue clopidogrel for 12 months
  - Balance potential reduction in ischaemic risk with risk of bleeding and consider:
    - adding a GPI (eptifibatide or tirofiban), or
    - bivalirudin as an alternative to the combination of a heparin plus a GPI if the patient is not on fondaparinux or a GPI and angiography is scheduled within 24 hours of admission

- **High risk** (> 6.0–9.0%)

- **Highest risk** (> 9.0%)

- Offer coronary angiography (with follow-on PCI if indicated) within 96 hours of first admission unless contraindicated. Perform as soon as possible if patient is clinically unstable or at high ischaemic risk

- Discuss management strategy with interventional cardiologist and cardiac surgeon. Consider angiographic findings, comorbidities and risks and benefits when discussing the choice of revascularisation strategy with the patient
Lower risk groups

- **Lowest risk (≤ 1.5%)²**
  - Initial conservative management
  - **Recurrent spontaneous ischaemia?**
  - **Yes**
    - Consider ischaemia testing
  - **No**
    - Consider ischaemia testing
  - **Ischaemia demonstrated?**
    - **Yes**
      - Conservative management
    - **No**
      - Conservative management

- **Low risk (> 1.5–3.0%)³**
  - Offer a single 300-mg loading dose of clopidogrel and continue clopidogrel for 12 months
  - **Coronary angiography**
  - **Yes**
    - Conservative management
  - **No**
    - Conservative management
Acute treatment

1. Anti-ischaemic medication
2. Anti-platelet agents
3. Anti-coagulants
4. Revascularisation
1. Anti-ischaemic medication

• $\beta$-blockers
• Calcium channel blockers
• Nitrates
2. Anti-platelet agents

- **Aspirin** (ATT meta-analysis 2009)
  - RR 0.87 (0.78-0.98) for coronary heart disease deaths
- **Clopidogrel** (CURE 2001)
  - CV death/MI/CVA: Clopidogrel 9.3% Vs placebo 11.4%
  - ARR 2.1%; RRR 20%; NNT 48
- **Prasugrel** (TRITON 2007)
  - CV death/MI/CVA: Prasugrel 9.9% Vs Clopidogrel 12.1%
  - ARR 2.2%; RRR 27%; NNT 45
- **Ticagrelor** (PLATO 2009)
  - CV death/MI/CVA: Ticagrelor 9.8% Vs Clopidogrel 11.7%
  - ARR 1.9%; RRR 16%; NNT 53
Glycoprotein IIb/IIIa inhibitors

• ISAR-REACT2 (2006)
  – Death/MI/TVR: Abciximab 8.9% vs Placebo 11.9%; RR 0.75; 95% CI 0.58–0.97; P =0.03
3. Anti-coagulation

- Fondaparinux (OASIS-5)
- Bivalirudin (ACUITY)

*OR* and 95% CI from [Lancet 2000; 355: 1936-42]*
4. Revascularisation

<table>
<thead>
<tr>
<th>Study</th>
<th>Invasive Strategy</th>
<th>Conservative Strategy</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIMI IIIB10</td>
<td>122/895 (13.6)</td>
<td>171/915 (18.7)</td>
<td>0.75 (0.61-0.93)</td>
</tr>
<tr>
<td>MATE11</td>
<td>27/111 (24.3)</td>
<td>22/90 (24.4)</td>
<td>0.99 (0.52-1.90)</td>
</tr>
<tr>
<td>VANQWISH18</td>
<td>148/462 (32.0)</td>
<td>124/458 (27.7)</td>
<td>1.22 (0.92-1.61)</td>
</tr>
<tr>
<td>FRISC II</td>
<td>196/103 (17.9)</td>
<td>322/1102 (29.2)</td>
<td>0.53 (0.43-0.65)</td>
</tr>
<tr>
<td>TACTICS-TIMI 187</td>
<td>177/1114 (15.9)</td>
<td>215/1106 (19.4)</td>
<td>0.78 (0.63-0.97)</td>
</tr>
<tr>
<td>RITA 3</td>
<td>122/895 (13.6)</td>
<td>171/915 (18.7)</td>
<td>0.69 (0.53-0.88)</td>
</tr>
<tr>
<td>VINO20</td>
<td>5/64 (7.8)</td>
<td>19/67 (28.4)</td>
<td>0.21 (0.07-0.62)</td>
</tr>
<tr>
<td>ICTUS8</td>
<td>137/604 (22.7)</td>
<td>126/596 (21.1)</td>
<td>1.09 (0.83-1.44)</td>
</tr>
<tr>
<td><strong>Overall</strong></td>
<td><strong>1075/5083 (21.1)</strong></td>
<td><strong>1313/5067 (25.9)</strong></td>
<td><strong>0.78 (0.61-0.98)</strong></td>
</tr>
</tbody>
</table>

*JAMA. 2008;300(1):71-80*
Risk stratification and PCI

Cumulative Risk of CV Death or MI by Risk Group

(J Am Coll Cardiol 2010;55:2435-45)
Timing of PCI

![Graph showing the timing of PCI with recurrence ischaemia results](image)

- ABOARD: RR (95% CI) = 0.64 (0.39, 1.07)
- ELISA: RR (95% CI) = 0.95 (0.47, 1.92)
- ISAR-COOL: RR (95% CI) = 0.71 (0.45, 1.11)
- TIMACS: RR (95% CI) = 0.31 (0.18, 0.54)

Overall (Random effects): RR (95% CI) = 0.59 (0.38, 0.92)
Overall (Fixed effects): RR (95% CI) = 0.57 (0.44, 0.74)

*European Heart Journal (2011) 32, 32–40*
**ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation**

### Recommendations for invasive evaluation and revascularization

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>An invasive strategy (within 72 h after first presentation) is indicated in patients with: • at least one high-risk criterion (Table 9): • recurrent symptoms.</td>
<td>I</td>
<td>A</td>
<td>148</td>
</tr>
<tr>
<td>Urgent coronary angiography (&lt;2 h) is recommended in patients at very high ischaemic risk (refractory angina, with associated heart failure, life-threatening ventricular arrhythmias, or haemodynamic instability).</td>
<td>I</td>
<td>C</td>
<td>148, 209</td>
</tr>
<tr>
<td>An early invasive strategy (&lt;24 h) is recommended in patients with a GRACE score &gt;140 or with at least one primary high-risk criterion.</td>
<td>I</td>
<td>A</td>
<td>212, 215</td>
</tr>
</tbody>
</table>

### Table 9 Criteria for high risk with indication for invasive management

**Primary**
- Relevant rise or fall in troponin
- Dynamic ST- or T-wave changes (symptomatic or silent)

**Secondary**
- Diabetes mellitus
- Renal insufficiency (eGFR <60 mL/min/1.73 m²)
- Reduced LV function (ejection fraction <40%)
- Early post infarction angina
- Recent PCI
- Prior CABG
- Intermediate to high GRACE risk score (Table 5)
Conclusion

**NSTEACS**

- **Very high risk**
  - Immediate invasive strategy

- **High risk**
  - Early invasive strategy
  - Within 24hrs

- **Low risk**
  - Conservative treatment
  - Functional testing

ESC Guidelines 2011
ST Elevation MI
• **Fundamentals**
• **Prevention (PAD)**
• **Acute treatment**
  
  **Time to reperfusion**
  ‣ Networking

**Pharmacological environment and PPCI technique**
  ‣ Quality of reperfusion (distal embolisation, no-reflow)
  ‣ Rate of reinfarction
  ‣ Haemorrhage

**Early discharge**

• **Lifestyle changes, rehabilitation, secondary prevention**
• **Challenges**
Plaque rupture
Plaque erosion
Calcific nodule ulceration
Spontaneous dissection
Emboliisation
Platelet activation
Thrombin generation
Platelet aggregation
Fibrin formation
Objectives of acute STEMI treatment:

1. Restoring epicardial coronary flow and **myocardial tissue reperfusion** to minimise myocyte necrosis

2. Reduce rate of reinfarction and haemorrhagic complications

3. Prevent/treat dysrhythmia

4. Medium and long-term lifestyle changes and therapies to reduce recurrent MI
Fundamentals

- est. incidence 110,000 MI pa in the UK (c. 31000 STEMI in 2011/2)
- est. prevalence 850,000 who have had an MI (35-75)
- est. prevalence 1.4 million who have had an MI (all ages)

Mortality from coronary disease

<table>
<thead>
<tr>
<th></th>
<th>Population in 2020</th>
<th>2004 Mortality rate per 10^5</th>
<th>Number of deaths in 2020</th>
<th>Number of deaths in 2004</th>
<th>Excess deaths</th>
<th>Relative increase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MEN</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>35-44</td>
<td>3,784,099</td>
<td>0.300</td>
<td>598</td>
<td>714</td>
<td>-46</td>
<td>0.94</td>
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<td><strong>WOMEN</strong></td>
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<td>35-44</td>
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<td>25963</td>
<td>17493</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>75,156</strong></td>
<td><strong>51,220</strong></td>
<td><strong>24,046</strong></td>
<td>1.39</td>
</tr>
</tbody>
</table>

MEN & WOMEN TOTAL: 126,895, 92,380, 34,515
Lessons from fibrinolysis

- Reperfusion therapy improves survival
- The effect is time-dependent

Boersma et al. Lancet 1996
% events at 6 weeks

Meta-analysis of 23 RCTs n=7739

- PPCI is superior to lysis
- Rationale for 24/7 services

Keeley et al Lancet 2004

- Primary PCI is superior to lysis
- Rationale for 24/7 services
Mortality in England and Wales during NIAP 2006

courtesy J Birkhead

• Trial results can be reproduced in UK daily practice
90% of eligible for PPCI received PPCI
68% of eligible for lysis received lysis

• Primary PCI is the dominant reperfusion strategy in the UK
• Primary PCI is associated with increased access to reperfusion
Networks and protocols are essential
Clinical diagnosis

- Solely based on clinical presentation and 12 lead ECG (serial)
- Persistent ST elevation
- Challenging ECGs/presentations

LBBB, paced rhythm, posterior STEMI, ST elevation aVR, repolarisation patterns, perimyocarditis, LVH, previous infarction, LV aneurysm, takutsubo, acute PE, aortic dissection

‘False’ activations common (2.3-14%) but not detrimental to patient care

- Acute cardiovascular disease (60%)
- Isolated ECG changes (32%)
- Acute non-cardiovascular (8%)

Factors associated with no culprit found include

- age<45, LBBB, female gender, previous MI, ED activation (ROC 0.67)
### Fundamentals

<table>
<thead>
<tr>
<th>Dysrhythmia on transfer</th>
<th>n=1497</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VT/VF</td>
<td>49</td>
<td>3.1%</td>
</tr>
<tr>
<td>Bradyarrhythmia</td>
<td>9</td>
<td>0.6%</td>
</tr>
</tbody>
</table>

- Dysrhythmias pre-PPCI do not preclude transfer to a PCI-capable centre
- Patients with STEMI should be attached to an external defibrillator
Fundamentals

• PPCI is the preferred option when it can be performed:
• Expeditiously (UK C-2-B 150mins [nb ESC guidelines])
• By an experienced team (>400 PCI, >75 PCI/operator, >36 PPCI pa)
• <12 hrs after symptom onset (12-24 if clinically unstable class IIb)
  🌟 life-saving treatment
  🌟 reduced morbidity
<table>
<thead>
<tr>
<th>Mortality (%)</th>
<th>Lab (n=287)</th>
<th>CCU (n=149)</th>
<th>ED (n=448)</th>
</tr>
</thead>
<tbody>
<tr>
<td>In hospital</td>
<td>3.5</td>
<td>2.7</td>
<td>6.0</td>
</tr>
<tr>
<td>30 days</td>
<td>3.8</td>
<td>4.0</td>
<td>6.9</td>
</tr>
<tr>
<td>1 year</td>
<td>5.9</td>
<td>8.7</td>
<td>10.7</td>
</tr>
<tr>
<td>18 months</td>
<td>7.0</td>
<td>12.1</td>
<td>11.8</td>
</tr>
</tbody>
</table>

- Direct admission to lab is the optimal strategy.
time to reperfusion

Data from NRMI 2, 3, and 4

Pinto et al Circulation 2006
• Long term outcome also associated with short system delays
Pharmacological environment

- **Facilitated PPCI**

  Pharmacological reperfusion treatment delivered *prior* to immediate PCI in order to bridge the “PCI-related time delay”

  Full dose lytic, half-dose lytic + glycoprotein, and glycoprotein alone have been used to try to bridge the delays. No significant clinical benefit at the expense of more haemorrhagic complications.

- **Pharmacoinvasive PCI**

  Fibrinolysis followed by systematic transfer for PCI after 3-24hrs

- **Rescue PCI**

  Fibrinolysis followed by transfer for PCI only if failure to reperfuse

- **Interventional pharmacology for PPCI**

  Antiplatelet therapy

  Antithrombotic therapy

  ? high dose statin
<table>
<thead>
<tr>
<th>Pharmacological environment</th>
<th>Antiplatelet Rx</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO/PR/I V/NG</td>
<td>Aspirin</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>PO/NG</td>
<td>Thienopyridine</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>GpIIb/IIla (high thrombus burden)</td>
<td>IIa</td>
<td>A</td>
</tr>
<tr>
<td>IV</td>
<td>Abciximab</td>
<td>IIa</td>
<td>A</td>
</tr>
<tr>
<td>IV</td>
<td>Tirofiban</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>IV</td>
<td>Eptifibatide</td>
<td>IIb</td>
<td>C</td>
</tr>
<tr>
<td>Antithrombin Rx</td>
<td>Class</td>
<td>Level</td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>-------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>UFH</td>
<td>I</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>LMWH</td>
<td>IIa</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Bivalirudin</td>
<td>I</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>Fondaparinux</td>
<td>III</td>
<td>B</td>
<td></td>
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</tbody>
</table>
In hospital mortality

Overlap of factors for ischaemia and haemorrhage
Prediction of haemorrhagic risk in an individual challenge

Pharmacological environment

Haemodynamic effects
Transfusion effects
Activation of haemostasis, prothrombotic effects
Cessation of antithrombotic therapy

GRACE registry  n=24,045
Technique

- Culprit only (unless shock)
- Angioplasty alone can re-establish flow
- Stents prevent recurrent ischaemia/TVR
- Balloon-expandable DES>BMS (unless high thrombus burden/contraindications)
- ?Self-expanding stents
Early discharge

Zwolle risk score n=1791

Predictive ability (c-statistic 0.907)

- 0-2 days
- 3-10 days
- Total 30 day

- 73%
- 18%
- 3%
- 6%
• Patients post PPCI can be risk stratified.
Early discharge

- Log rank p=0.03
- TIMI 3 flow
- ST resolution
- EF>35%
- No dysrhythmia for 24hrs
- Social support

- Even cruder selection may be possible for discharge planning
In hospital case-fatality

Innovation

CCU 1961

Fibrinolysis 1986

Systematic PPCI 1993

Heart attack centre
My Patient Has Angina
What Next?

• Medical Therapy
• Percutaneous coronary Intervention (PCI)
  – Balloon angioplasty
  – Stents
• Coronary artery bypass grafting
Coronary angiography inside the cath lab

- X-ray image intensifier (camera)
- Monitors to view X-ray images and pulse BP etc
- Table (bed) where patient will lie
- Cath lab staff: Nurses, cardiac physiologists (tecs), radiographers, and doctors
What happens in a coronary angiogram?

Patient lies on the table

They are connected to ECG monitors

- Local anaesthetic to right or left groin and arterial access via a needle and then a tube in the femoral artery
What happens in a coronary angiogram or PCI?

The catheter - a flexible tube is passed against the flow of blood up the aorta and round the arch to the openings of the coronary arteries (ostea).

Dye is injected that shows up on an X-ray film.
What happens in a coronary angiogram?

- Left coronary artery
- Right coronary artery
- Artery totally blocked
Percutaneous Coronary Intervention

A tiny wire is put down the vessel
Filter wire, thrombectomy device

The grey sausage with two small marker dots is the balloon inflated in the narrowing

A balloon angioplasty is performed
What happens inside the vessel?

Before

After

The stenosis (narrowing) is pushed outwards into the wall creating a better flow of blood to the heart.
Stenting

A stent is deployed

Balloon deflated and removed
Stent left in the vessel
After Stenting

• Types of Stents
  – Drug eluting stents (=expensive – rarely re-narrow)
  – Bare metal stents (= cheap – can get narrow again)

• Stents are vulnerable to THROMBOSIS

• Patients must take 2 antiplatelet agents - Aspirin and Clopidogrel

= 1 year of Aspirin and clopidogrel
= 1 month of Aspirin and clopidogrel

Keep Taking The Tablets
Coronary Artery Bypass Grafting

Major surgery - heart function is taken over by a machine

5-10 days in hospital  Significant risks
Some people live longer
Good long term relief of symptoms
The Heart Of The Matter - Myocardial Infarction

A 56 yo man gets chest pain and calls 999

• The ambulance crew arrive and do an ECG
Acute Coronary Syndrome and Non ST elevation myocardial infarction

NSTEMI (NSTEACS)

- Check troponin T on arrival and 12 hours after symptom onset
- Risk stratify = GRACE risk score
- Full clinical history (including age, previous MI, previous PCI or CABG)
- Physical examination (including BP and HR)
- Twelve-lead resting ECG
- Blood tests (such as troponin T, creatinine, glucose and haemoglobin)
What does he need?

- Get the blood back into his heart
- Early Reperfusion
- Thrombolysis - clot dissolving intravenous medication
  - Pre hospital given by ambulance crews
  - Given in hospital (Aim to give 20 min)
- Primary angioplasty
Primary angioplasty gives better results than thrombolysis

Several trials and meta-analyses have found fewer major adverse events with primary PCI

One of the most important- the DANAMI study- looked at patients who had to be transferred to hospitals up to 3 hours away
The next slide shows the results....
**DANAMI-2**

Death, re-infarction, disabling stroke at 30 days

<table>
<thead>
<tr>
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<th>Thrombolysis</th>
<th>PCI</th>
<th>p value</th>
<th>NNT</th>
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<tbody>
<tr>
<td>All hospitals</td>
<td>13.7%</td>
<td>8.0%</td>
<td>0.0003</td>
<td>18</td>
</tr>
<tr>
<td>District hospitals</td>
<td>14.2%</td>
<td>8.5%</td>
<td>0.002</td>
<td>18</td>
</tr>
<tr>
<td>Intervention Centres</td>
<td>12.3%</td>
<td>6.7%</td>
<td>0.048</td>
<td>17</td>
</tr>
</tbody>
</table>

Randomised within **12 hours** of symptom onset.
3 **additional** hours allowed for transport

Andersen et al. XIVth World Congress of Cardiology, 2002
The Heart Hospital
Straight To The Cath Lab

TIME is MUSCLE- Muscle is survival
Post PCI Mortality by Syndrome

2005 data: Ludman
4.35 Million die of CVD per year in Europe

Our 56 yo – wasn’t one of them
LAD artery reopened

Before PPCI
LAD artery reopened

Thrombectomy device

Angioplasty
LAD artery reopened

Before PPCLI

After PPCLI
Make no mistake about it, I understand how tough it is, sir. I talk to families who die.

December 7, 2006
**Case Presentation - STEMI**

Age: 58 years  
Gender: Female

### Clinical Presentation
- Central chest pain radiating to jaw
- 1st presentation

### ECG
- Inferior ST elevation

### Past Medical History
- nil

### Risk Factors
- HPT
- Chol
- FHx

### Direct Ambulance admission
Case Presentation - STEMI
LAD-Cx
RCA

Temporary Pacing Wire
PCI to RCA

Spider Distal Protection Device
PCI to RCA

Export Thrombus Aspiration Catheter
PCI to RCA

BMS (4 x 28mm)
PCI to RCA
PCI to RCA
Case Presentation - NSTEMI

68 ♂ Retired truck driver

Chest pain
Onset 0930
Presented to A&E 1308
Arrived at THH 1500

2 weeks similar pains on exertion

RFx

Elevated blood pressure
Ex smoker
Family history of ischaemic heart disease

Initial examination: Normal
ECG: Normal

Troponin within 2hrs: 0.06
Case Presentation - NSTEMI
Cardiac Catheterisation
Right Radial Artery
Left system
RCA
PCI-RCA

BMS 4 x 16mm
PCI-RCA
Case Presentation – Unstable Angina

Age: 54 years  
Gender: Male

**Clinical Presentation**
- chest pain  
- 1 week history of chest pain on exertion

**ECG**

**Past Medical History**
- Nil of note

**Risk Factors**
- HTN
Case Presentation – Unstable Angina
RCA
PCI to RCA
<table>
<thead>
<tr>
<th>Unstable Angina</th>
<th>NSTEMI</th>
<th>STEMI</th>
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</thead>
<tbody>
<tr>
<td>Non occlusive thrombus</td>
<td>Occluding thrombus sufficient to cause tissue damage &amp; mild myocardial necrosis</td>
<td>Complete thrombus occlusion</td>
</tr>
<tr>
<td>Non specific ECG</td>
<td>ST depression +/- T wave inversion on ECG</td>
<td>ST elevations on ECG or new LBBB</td>
</tr>
<tr>
<td>Normal cardiac enzymes</td>
<td>Elevated cardiac enzymes</td>
<td>Elevated cardiac enzymes</td>
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<tr>
<td></td>
<td></td>
<td>More severe symptoms</td>
</tr>
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</table>
ECG assessment

ST Elevation or new LBBB
STEMI

ST Depression or dynamic T wave inversions
NSTEMI

Non-specific ECG
Unstable Angina
Secondary Prevention

- **Disease**
  - HTN, DM, Chol

- **Behavioral**
  - smoking, diet, physical activity, weight

- **Cognitive**
  - Education, cardiac rehab program
Secondary Prevention
disease management

- **Blood Pressure**
  - Goals < 140/85 or <130/80 in DM /CKD
  - Maximize use of beta-blockers & ACE-I

- **Lipids**
  - Chol < 4.0 ; LDL < 2.0 ; (20% Chol ; 30% LDL)
  - Maximize use of statins;
    (consider fibrates/niacin ; consider omega-3 fatty acids)

- **Diabetes**
  - Fasting glucose less than 6.0mmol/L
  - HbA1c < 6.5%
Secondary prevention
behavioral intervention

- **Smoking cessation**
  - Cessation-class, meds, counseling

- **Physical Activity**
  - Goal 30 - 60 minutes daily
  - Risk assessment prior to initiation

- **Diet**
  - Fresh fruit/vegetables (5 a day), omega-3 fatty acids (Fish 2 servings per week)
  - <7% total calories from saturated fats
Secondary prevention cognitive

- Patient education
  - In-hospital – discharge – outpatient clinic/rehab

- Monitor psychosocial impact
  - Depression/anxiety assessment & treatment
  - Social support system
Medication Checklist after ACS

- **Antiplatelet agent**
  - Aspirin and
    - Clopidogrel
    - Prasugrel
    - Ticagrelor

- **Lipid lowering agent**
  - Statin
  - Fibrate / Niacin / Omega-3

- **Antihypertensive agent**
  - Beta blocker
  - ACE-I/ARB

**At least 1 year**

**Titrate Up**
Long term management

- **Statins** for all initiated early with aim LDL<2
- **Betablockers** to all with LVEF <40%
- **ACE inhibitors** to all with LVEF<40%, HF, Diabetes, HTN or Kidney disease
- **Aldosterone antagonists** to patients already on BB/ACEi with LVEF <35%
- **Cardiac rehab**

*European Heart Journal (2011) 32, 32–40*
Case Presentation - Stent Thrombosis

Age:  64 years
Gender: Male

Clinical Presentation

Severe Central chest pain
Prev LAD stent - 9 months ago

Clopidogrel stopped 1 week prior due to elective orthopedic surgery

Past Medical History

Cervical myelopathy

Risk Factors

ExSmoker
Chol
HTN

ECG

Anterior ST elevation
Export Thrombectomy Catheter
Intravascular Ultrasound
Balloon Angioplasty
LAD
Discussion
EVERYTHING IS FINE. THE TITLE IS OURS!
How good are the tests?

- Resting ECG
- Exercise test
- CT Calcium score
- Perfusion scan
- Stress echo
- Angiogram
Typical rise and gradual fall of biochemical markers of myocardial necrosis

With at least one of the following
1. Ischaemic symptoms
2. Development of Q waves on the ECG
3. ECG changes indicative of ischaemia
4. Imaging evidence of new loss of viable myocardium or new regional wall motion abnormalities
Pathophysiology of acute coronary syndromes

Platelet

Red Blood Cell

Fibrin

Clot formation

Coronary thrombosis

Mural thrombus

Distal embolization

Occlusive thrombus

Non ST-elevation ACS

ST-elevation ACS
Slide on Prasugrel and Ticagrelor
Slide on Maximum titrated doses of Bblockers and ACEI

Slide on Rehab and secondary prevention
Acute Coronary Syndromes

Mick Ozkor
Consultant Cardiologist
The Heart Hospital
North Middlesex Hospital
CHD single leading cause of death in United States
  - 452,327 deaths in the U.S. in 2004

1,200,000 new & recurrent coronary attacks per year

38% of those who with coronary attack die within a year of having it

Annual cost > $300 billion
Normal or non-diagnostic EKG
ST Depression or Dynamic T wave Inversions
Acute Coronary Syndrome

- Ischemic Discomfort
  - Unstable Symptoms
    - No ST-segment elevation
    - ST-segment elevation
      - Unstable Non-Q AMI
      - Q-Wave AMI

- History
- Physical Exam
- ECG
- Acute Reperfusion
ST-Segment Elevation MI
New LBBB

QRS > 0.12 sec
L Axis deviation
Prominent R wave V1-V3
Prominent S wave 1, aVL, V5-V6
with t-wave inversion
Diagnosis of Acute MI

STEMI / NSTEMI

- At least 2 of the following
  - Ischemic symptoms
  - Diagnostic ECG changes
  - Serum cardiac marker elevations
Ischaemia testing algorithm

- **More or recurrent pain?**
  - Yes
    - Expedite transfer to the Heart Hosp.
    - After discussion with Cardiology SpR/Cons, start: Abciximab/
  - No
    - Female, ECG uninterpretable or pt has mobility problems, then myocardial perfusion imaging
      - Positive at >5<10 METS, arrange OP angio (soon) Continue clopid. and other meds as needed.
      - Positive at <5 METS, coronary angiography +/- stent
      - >10 METS without symptoms or ECG changes, then discharge.
      - STOP clopidogrel and review other drugs.
  - Male
    - Consider prompt ETT
Recent onset stable chest pain – the NICE thing to do
QUESTIONS

• WHO TO REFER

• HOW WILL THEY BE ASSESSED
Chest Pain of Recent Onset

Mick Ozkor
Consultant Cardiologist
Likelihood of coronary artery disease

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Non-anginal chest pain</th>
<th>Atypical angina</th>
<th>Typical angina</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men Lo</td>
<td>Hi</td>
<td>Women Lo</td>
</tr>
<tr>
<td>35</td>
<td>3</td>
<td>35</td>
<td>1</td>
</tr>
<tr>
<td>45</td>
<td>9</td>
<td>47</td>
<td>2</td>
</tr>
<tr>
<td>55</td>
<td>23</td>
<td>59</td>
<td>4</td>
</tr>
<tr>
<td>65</td>
<td>49</td>
<td>69</td>
<td>9</td>
</tr>
</tbody>
</table>

For men older than 70 with atypical or typical symptoms, assume an estimate > 90%.
For women older than 70, assume an estimate of 61–90% EXCEPT women at high risk AND with typical symptoms where a risk of > 90% should be assumed.

Hi = High risk = diabetes, smoking and hyperlipidaemia (total cholesterol > 6.47 mmol/litre).
Lo = Low risk = none of these three.

NICE clinical guideline CG95 Chest pain of recent onset