Chest pain is one of the most common and important presenting symptoms in our daily clinical visits. On the surface of Planet Earth, there are 13.2 million Homo sapiens suffering from ischaemic heart disease. The number of sufferers is still increasing, by a rate of 1.2 million more per year. In the United States, there are 7 million chest pain visitors to the ER (Emergency Room) per year. 15-25% of these chest pain sufferers are real cases of acute coronary syndrome (ACS - unstable angina or acute myocardial infarction). Unfortunately, 2% of these ACS sufferers were discharged with their diagnosis missed by our ER colleagues. The mortality rate of the missed cases is two times more than those admitted. In the United Kingdom, 5% of men and 4% of women have or have had angina. There are a total of 320,000 chest pain consultations for the NHS (National Health Service) every year. In Hong Kong, heart disease is the second killer since 1960’s. There were 5,169 citizens killed by heart disease in 2006. For Hospital Authority admissions under the diagnosis of ischaemic heart disease (Arrhythmia, congestive heart disease and myocardial infarction were excluded. Many of them were also caused by ischaemic heart disease), there were 17,523 admissions in 2003. In other words, there were about 48 ischaemic heart disease admissions every day.

In this article, I will discuss the following topics in a simple and practical way:

1. What are the causes of chest pain and how to differentiate them clinically?
2. What are the investigations and how useful they are?
3. Local chest pain management guidelines for Family Doctors - my humble suggestions (with reference to the updated ACC/AHA Guidelines).

Moreover, I will go through the key messages again in my favourite topic - "In a Nutshell" before the end.

Because of the limited space in this issue of the Hong Kong Medical Diary, for those who want to read more on the pathophysiology, medical and interventional management of ischaemic heart disease, please kindly go to the web site, http://www.hkma.org/chinese/cme/cme.htm. You can download my articles (free of charge) in the Hong Kong Medical Association CME Bulletin: Ischaemic Heart Disease - A Guide to Clinical Practice

Part I Issue July 2006
Part II Issue August 2006

Once again, I sincerely hope that this article is simple, easy and useful for your daily clinical practice.

What are the Causes of Chest Pain and How to Differentiate Them Clinically?

William Heberden (1710-1801) was the first doctor to recognize and to describe angina pectoris in detail. Actually, apart from the pain character, he had no idea of any relationship between angina and the heart. 100 years later, James Bryan Herrick (1861-1954) presented his landmark paper "Modern Concept of Coronary Thrombosis and Myocardial Infarction" before the Association of American Physicians in 1912. He marked the dawn of the important modern concept of coronary thrombosis and myocardial infarction.

The keys for the clinical differentiation of chest pain and discomfort are:

1. Character
2. Location
3. Precipitating Factors

We can simply classify the major differential diagnoses for chest pain and discomfort as below:

1. Cardiac
2. Vascular
3. Pulmonary
4. Gastrointestinal
5. Musculoskeletal
6. Infectious
7. Psychological
The following Table 1 is very simple, straightforward and useful for clinical use:

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Apart from my table above, there are two very simple but useful guidelines for your daily clinical use.

1. National Heart Attack Alert Programme 1994

Chief Complaints that indicate the immediate need of medical & cardiac care:
- Chest pain, pressure, tightness or heaviness; pain that radiates to neck, jaw, shoulders, back, or one or both arms
- Indigestion or heartburn; nausea and/or vomiting associated with chest discomfort
- Persistent shortness of breath
- Weakness, dizziness, lightheadedness, loss of consciousness

2. ACC/AHA Guidelines Update for The Management of Patients with Unstable Angina and Non-ST-segment Elevation Myocardial Infarction-2002

Pain not characteristic of angina
- Sharp/knife - like pain with respiration/cough (Pleuritic Pain)
- Primary mid/lower abdominal discomfort
- Pain can be localised at the tip of one finger, especially over the left ventricular apex

Moreover, chest pain in women is more difficult to assess even with non-invasive tests. Very careful history and risk assessment are our key to success.

Before thinking about investigations, before reaching a definite diagnosis, before the planning of immediate management and before thinking about the prognosis..., we must first ask ourselves the followings three life saving questions:

1. What is the clinical stability of the patient?
   - Does the patient need immediate resuscitation for circulatory and/or respiratory collapse?
   - If the answer is Yes
   - Advanced Cardiac Life Support (ACLS) / Basic Cardiac Life Support (BCLS) in your clinic then,
   - Transfer the patient to a private/public hospital as soon as possible.

If the patient is clinically stable, then ask...

2. What is the immediate prognosis of the patient?
   - What is the risk that the patient is suffering from life-threatening conditions, eg. ACS, aortic dissection, pulmonary embolism?
   - If is answer is Yes again...
   - Transfer to a private/public hospital as soon as possible

3. What is the degree of the safety of referral
   - If the risk of life-threatening conditions are low, would it be safe to discharge the patient for
   - private specialist (may need to wait for hours to days) or
   - public specialist (may need to wait for days up to years) or
   - should we (as a family doctor) directly refer the patient for further investigation and/or observation to guide for further management?
What Are The Investigations and How Useful They Are?

In this short session, we are going to talk about the indications, pros and cons for:

- ECG
- Serum Cardiac Markers
- Treadmill Stress ECG Examination
- Imaging Modalities

**Electrocardiogram (ECG)**

ECG is one of the oldest but still useful investigation in the world of cardiology. The first commercial ECG machine model was sold exactly one hundred years ago, in 1908, by the Cambridge Scientific Instrument Company of England.6

ECG is the least expensive, least technically challenging (can be easily performed by nurses and technicians) and fastest "Point - of - Care" test (can be performed swiftly, on-site, within 3 minutes). Compared with the newer investigation modalities, ECG is of course, not as sensitive and specific.

According to the AHA-ACC Statement 2004’ 12-leads resting ECG should be obtained within 10 minutes of presentation in a patient with on-going chest pain.9 There are a lot of individual differences between resting ECGs. Old ECG is always extremely useful for comparison.

The following very robust data mark the importance & usefulness of resting ECG:

- For patients with ≥1mm New ST elevation, 80% of them are suffering from acute myocardial infarction.
- For patients with New ST depression / T inversion, 20% of them are suffering from acute myocardial infarction.
- For patients with No ischaemic changes
  - In patients with past medical history of ischaemic heart disease, 4% of them are suffering from acute myocardial infarction
  - In patients without past medical history of ischaemic heart disease, only 2% of them are suffering from acute myocardial infarction10

In view of the above, my humble suggestion is, all family doctors should purchase an ECG machine (the most money-valued ones only cost a few thousands Hong Kong dollars) for their clinics.

One last important word on ECG, ECG is unfortunately, one of the most common arenas for malpractice, human lives and medico-legal losses because of:-

- failure to obtain an ECG on a chest pain patient,
- failure to correctly interpret the ECG obtained and most catastrophically,
- discharge the patient with an abnormal ECG home, without the indicated further evaluation and management10

**Blood Tests**

Currently, there are 2 standard blood tests for acute coronary syndrome, Cardiac Troponin (I & T) and CKMB. Please kindly forget the old tests, SGOT, LDH, and CK, for they are no longer recognised as useful cardiac markers.

**Cardiac Troponin I & T8**

- Preferred 1st line cardiac markers because of higher specificity (ACC/AHA/ESC)
- No practical difference between I & T
- An indicator of poorer prognosis even in the presence of normal CKMB
- "Point of care" bedside test, result can be available in 15 mins; for laboratory test, result can be available in 30 -45 mins,
- Inexpensive, cost less than a few hundred Hong Kong dollars per test
- If first set of blood is negative, repeat the test 6 - 12 hours later, if still negative, the negative predictive value is extremely high (>95% sensitivity and specificity)

**CKMB (mass)8**

- Serves as an alternative test to Troponin, if Troponin test is not available
- In A&E with chest pain, sensitivity 34%, specificity 88%
- Within 4 hours of chest pain onset, sensitivity <25%
- More then 12 hours of chest pain onset, sensitivity 70 - 90 %
- CKMB can be false positive in patients with
  - Muscular dystrophy
  - High performance athletics
  - Rhabdomyolysis
  - Alcoholics
  - Trauma

One vital point, all blood tests must be ordered and interpreted with careful consideration within the whole clinical context (This is universally true for all sorts of investigations. If you are interested, please read the Bayesian Principle):

- A normal test result in a patient with high clinical probability of ACS does not exclude the diagnosis;
- Patients with very low probability of ACS should not undergo the tests because of the possibility that false positive results will lead to unnecessary hospitalisations, tests, procedures and their complications

**Treadmill Exercise Stress ECG Examination11**

Treadmill examination is the most widely used, inexpensive (just costs you about one thousand something up to a few thousand Hong Kong dollars, depending on the level of expertise), non-invasive and quick test (results can be obtained within 20 minutes!) in the world of cardiology.

The following chest pain patients with low clinical risk can safely undergo exercise testing within 6 to 12 hours or even immediately:

- 2 sets of normal cardiac markers at 4 hours interval
- Normal ECG at presentation and pre-exercise examination

- In patients with past medical history of ischaemic heart disease, 4% of them are suffering from acute myocardial infarction
- In patients without past medical history of ischaemic heart disease, only 2% of them are suffering from acute myocardial infarction10
Absence of resting ECG abnormality that precludes accurate exercise ECG assessment (for example, LBBB)

- Since clinical presentation, the patient:
  - remains asymptomatic
  - with improving chest pain symptoms
  - with persistent atypical chest pain symptoms

- Absence of typical ischaemic chest pain at the time of exercise testing

Treadmill stress ECG examination provides reliable prognostic information for low risk patients with test performed within 48 hours of clinical presentation:

- Positive or equivocal examination result \(\rightarrow 15\%\) six month event rate
- Negative examination result \(\rightarrow 2\%\) six month event rate\(^{11}\)

Treadmill stress ECG examination is very safe. In my over 15 years’ experience (Lucky?!), I do not have a single case of morbidity and mortality for my chest pain patients. Still, there are some contraindications that need to be observed carefully:

- New or evolving resting ECG abnormalities
- Abnormal Cardiac blood markers
- Inability to perform treadmill exercise (neurological and lower limb musculoskeletal disease)
- Worsening of chest pain symptoms since presentation
- Clinical risk profiling indicating imminent coronary angiography is indicated\(^{12}\)

**Imaging Tests**

Imaging tests are good for chest pain patients who cannot perform treadmill stress ECG examination or their resting ECG abnormality affecting the accuracy of Treadmill ECG interpretation (for example. LBBB)

- Resting Echocardiogram
- Stress Echocardiogram (Exercise/Dobutamine)
- Nuclear Myocardial Perfusion Scan (Resting + Stress)
- CT coronary angiogram
- MRI myocardial perfusion and anatomy scan

In general they have the following characteristics:

- More sensitive and specific
- Ability to quantify the degree and extent of ischaemia
- Expensive (From a few thousand to over ten thousand Hong Kong Dollars per each examination)
- Invasive (except resting echocardiogram)
- Less readily available

Each test is different in their strong and weak areas, price, indication and the degree of invasiveness. The technology is also advancing in light speed. New data keep popping up every month. I would like to sincerely ask my family practice colleagues to consult their cardiologist friends before booking.

**Local Chest Pain Management Guidelines for Family Doctors**

~ My Humble Suggestions (With Reference to the Updated ACC/AHA Guidelines 2002)~

This following is my favourite table. I have modified it from the AHA/ACC statement for our local use. It can help you to point out the likely signs and symptoms towards or the likelihood of ACS (unstable angina and acute myocardial infarction)\(^{13}\)

| Table 2 |
|-----------------|-----------------|-----------------|-----------------|
| **Features**    | **High likelihood** | **Intermediate likelihood** | **Low likelihood** |
| **History**     | Chest or left arm discomfort reproducing prior documented angina | Age > 70 or Male | Probable ischaemic symptoms in the absence of the intermediate and high likelihood characteristics |
| **Examination** | Mitral Regurgitation | Estacardiac vascular disease | Chest discomfort reproduced by palpitation |
| **ECG**         | New ST elevation \(\geq 1 \text{mm}\) | Fixed Q waves Old Abnormal ST segments or T waves | T wave flattening in leads with tall R waves and Normal ECG |
| **Cardiac Markers** | Cardiac Troponin I | Normal | Normal |
| **Cardiac Troponin T** | Cardiac Troponin T | | |
| **CKMB** | | | |

This is my second beloved table. I have also modified it from the AHA/ACC statement for our local use. Once your diagnosis is ACS, it can help you to further risk stratify your patient. That is the likelihood of your patient, heading towards catastrophic results (Death or Nonfatal Myocardial Infarction)\(^{13}\)

**The Short Term Likelihood of Death or Nonfatal Myocardial Infarction in Unstable Angina Patients**\(^{13}\)

| Table 3 |
|-----------------|-----------------|-----------------|-----------------|
| **Feature** | **High likelihood** (Any of the following) | **Intermediate likelihood** (Absence of High-Likelihood Features & presence of any of the following) | **Low likelihood** (Absence of High- or Intermediate-Likelihood Features & presence of any of the following) |
| **History** | Accelerating tempo of ischaemic symptoms in the preceding 48 hours | History of MI, PVD, CVA, CABG, Aspirin usage | New/Progressive Canadian Cardiovascular Class II/V angina, in past 2 weeks, without >20mins resting angina, with moderate or high likelihood of CAD |
| **Pain Character** | Resting angina \(\geq 20\text{mins}\) | Resolved Resting angina \(\geq 20\text{mins}\) with moderate or high likelihood of CAD | Age \(> 70\) |
| **Clinical findings** | Pulmonary oedema | New or worsening mitral regurgitation, S3/Gallop rhythm, Lung crepitations, Abnormal BP, HR, TNG \(\geq 70\) | Normal/Unchanged ECG during chest pain |
| **ECG** | Resting angina with ST elevation \(\geq 1 \text{mm}\) | T wave inversion \(> 4 \text{mm}\) | Normal |
| **Cardiac Markers** | Cardiac Troponin T \(> 0.1 \text{ng/ml}\) | Slightly elevated | Normal |

The following are my humble suggestions for my dearest family practice and non-cardiac specialty colleagues:
My Tips for Management:

Once you know all the above points, the management of ACS is simple. I have 3 last tips for all my dearest family doctors:

1. For ACS patients with
   - Short Term risk of Death or Nonfatal Myocardial Ischaemia likelihood is high to intermediate:
   - Immediate transfer to a private/Hospital Authority hospital with prior notification to cardiologist/Emergency doctors, for the urgent management of ACS

2. For chest pain/angina patients with
   - Short Term risk of Death or Nonfatal Myocardial Ischaemia likelihood is low
   - Refer to Private specialist (may take hours to days) / Hospital Authority Specialist Clinics (may take weeks to months), for further investigations and risk stratification

3. The most important key for success is a good history taking, meticulous physical examination, carefully selected rapid investigations with a prompt and precise management; delivered within a mutual understanding and intimate trust between patients and doctors.

In a Nutshell

1. Chest pain is a very common presentation in our daily practice
2. Heart disease is the 2nd Killer in HK
3. The key for differentiation is
   - Character
   - Location
   - Precipitating Factors
4. Before reaching a definite diagnosis, we must first ask ourselves
   - Clinical stability
   - Immediate prognosis
   - Safety of referral
5. ECG Should be obtained and interpreted within 10 mins of presentation in a patient with ongoing chest pain
6. Cardiac Troponin I & T
   - are the preferred 1st line markers,
   - if the first set of blood is negative ‘ repeat in 6 to 12 hours
7. Treadmill Stress ECG examination is a very useful diagnosing and risk stratification tool for low risk patients on Day 1 of presentation
8. Refer the ACS patients to a private/Hospital Authority hospital immediately for urgent management of ACS:
   - if the Short Term risk of Death or Nonfatal Myocardial Ischaemia likelihood is high to intermediate.

References


Every adversity, every failure and every heartache carries with it the seed of an equivalent or a greater benefit.

~ Napoleon Hill (1883 - 1970)