Approach to Chest Pain: CTCA and Calcium Score and Their Relationship to Stress Echocardiography

GP Seminar, Cardiology at the Mater

Saturday, 23 October, 2021

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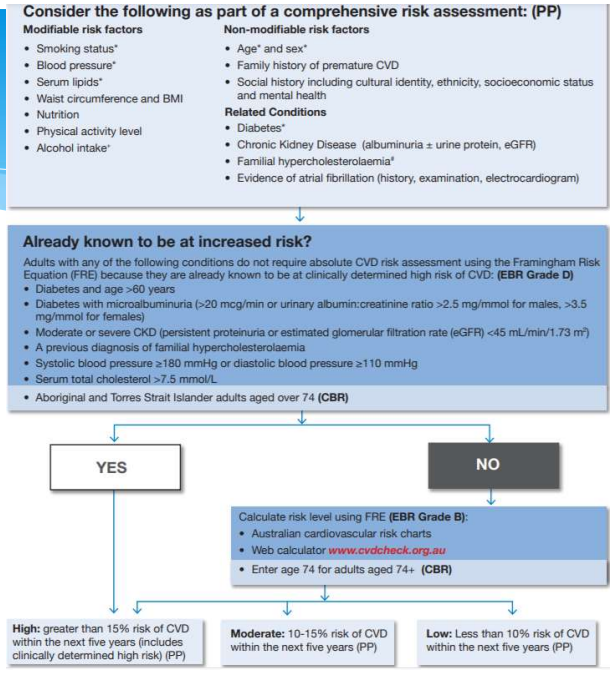
Introduction

- New technology, new research, new indications, new procedural algorithms
- Assessing cardiovascular risk for primary prevention
  - Framingham risk score and RACGP guidelines
  - MESA score and coronary artery calcium score
- Assessment of grade of risk in the patient with chest pain
  - Investigations in patients with low to intermediate risk chest pain
  - CT coronary angiography, stress echocardiography, myocardial perfusion imaging
- Other uses for cardiac CT scanning

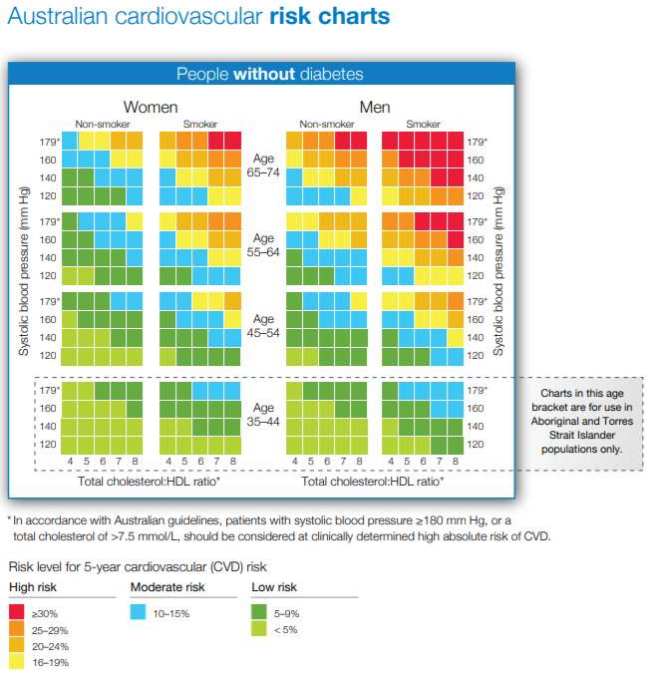
Assessment of Cardiovascular Risk

- Patients over the age of 40 or in high-risk groups require assessment of cardiovascular risk
- This includes the risk of ischaemic heart disease, cerebrovascular disease, peripheral arterial disease, and aortic disease
- In asymptomatic patients, assessment of risk includes assessment of risk factors and consideration of high-risk or special groups
- Several risk calculators for cardiovascular risk exist
  - Framingham risk score (5 year risk): e.g. https://www.cvdcheck.org.au/
  - ASCVD risk score (10 year risk)
  - QRISK lifetime cardiovascular (long term)

Assessment of Cardiovascular Risk



Assessment of Cardiovascular Risk



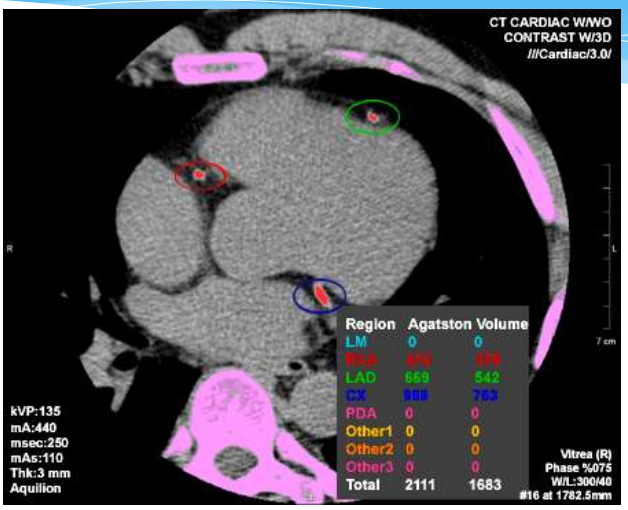
CT Calcium Score in Assessing Cardiovascular Risk

- MESA risk score and coronary artery calcium score
- A negative or very low calcium score (<10) can be used as a negative risk factor, particular in older patients with relative few risk factors apart from age
- When to use coronary artery calcium score?
  - Moderate risk patients
  - Less useful in many elderly patients
  - Assists in making decisions about statin therapy
- What does the score mean?

Table 1. Interpretation of coronary calcium score[3]

Calcium score	Interpretation	Risk of myocardial infarction/stroke at 10 years
0	Very low risk	<1%
1–100	Low risk	<10%
101–400	Moderate risk	10–20%
101–400 and >75th percentile	Moderately high risk	15–20%
>400	High risk	>20%

CT Calcium Score in Assessing Cardiovascular Risk



CT Calcium Score in Assessing Cardiovascular Risk

- What treatments should I institute?
  - Lipid-lowering therapy and antihypertensives
  - Aspirin if calcium score >100 and the patient is at least moderate risk
  - The “gatekeeper” for aspirin, statins, and intensification of antihypertensive regimes
- What else should I do?
  - Does not determine degree of coronary artery stenosis and does not detect soft plaque
  - High-risk or symptomatic patients require alternative testing (e.g. CT coronary angiogram or stress echocardiogram)
  - A high calcium score should prompt consideration for exclusion of significant coronary artery stenosis
  - Consider stress echocardiography or CTCA as well in certain patient groups to exclude significant stenosis caused by soft plaque
  - Not covered by MBS so cost may be a deterrent for some patients

CT Calcium Score in Assessing Cardiovascular Risk

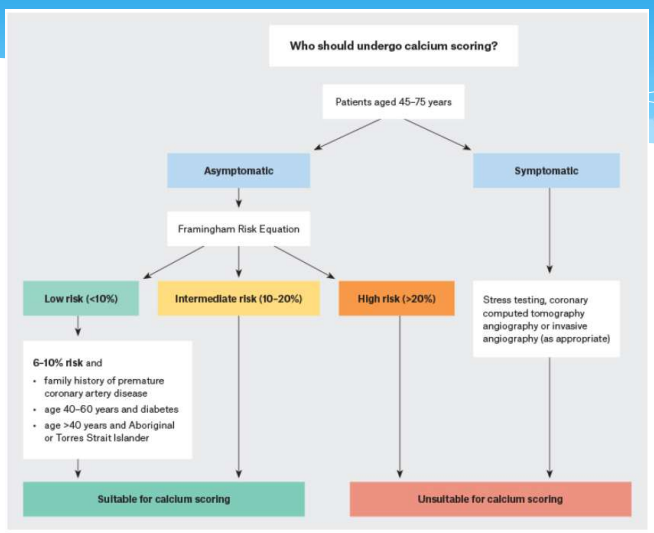


Figure 2. The Cardiac Society of Australia and New Zealand's recommended indications for coronary artery calcium scoring[3]

Grading Risk in a Patient Presenting With Chest Pain

- Patients may have stable symptoms or may present with acute chest pain
- Patients with chest pain, particular those presents with acute chest pain, need to have their symptoms taken seriously
- Patients, particularly those in certain groups, can have atypical presentations for ischaemic heart disease
- Any factors that indicate high-risk chest pain necessitate hospital admission and consideration of coronary angiography (and many patients with acute intermediate risk chest pain require hospital admission and further investigation)
- CT coronary angiography is changing how patients with chest pain are assessed and managed in the outpatient and the inpatient setting
- Patients with ECG changes, troponin elevation, or past history of coronary artery disease are automatically high-risk and non-invasive testing should not be considered first-line for them

Grading Risk in a Patient Presenting With Chest Pain

TIMI Risk Score for STEMI

Historical	
Age 65-74	2 points
≥ 75	3 points
DM/HTN or angina	1 point
Exam	
SBP < 100	3 points
HR >100	2 points
Killip II-IV	2 points
Weight < 67 kg	1 point
Presentation	
Anterior STE or LBBB	1 point
Time to rx > 4 hrs	1 point
Risk Score = Total	(0 -14)

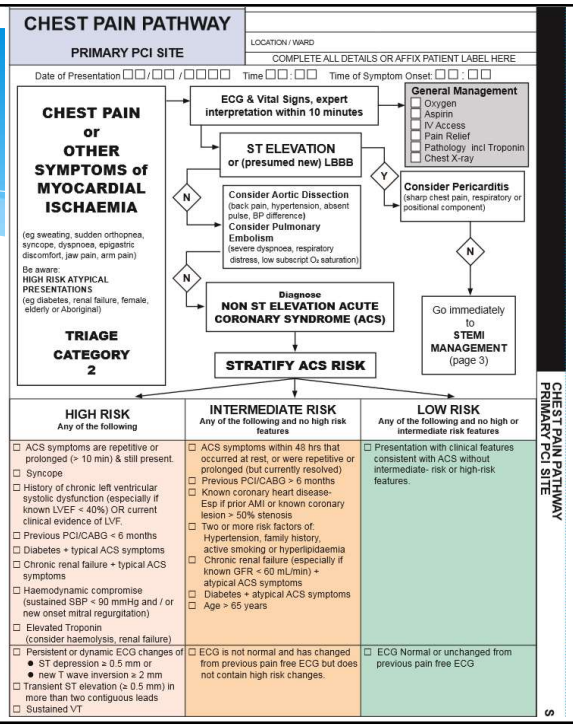
(FRONT)

Risk Score	Odds of death by 30D*	
0	0.1	(0.1-0.2)
1	0.3	(0.2-0.3)
2	0.4	(0.3-0.5)
3	0.7	(0.6-0.9)
4	1.2	(1.0-1.5)
5	2.2	(1.9-2.6)
6	3.0	(2.5-3.6)
7	4.8	(3.8-6.1)
8	5.8	(4.2-7.8)
>8	8.8	(6.3-12)

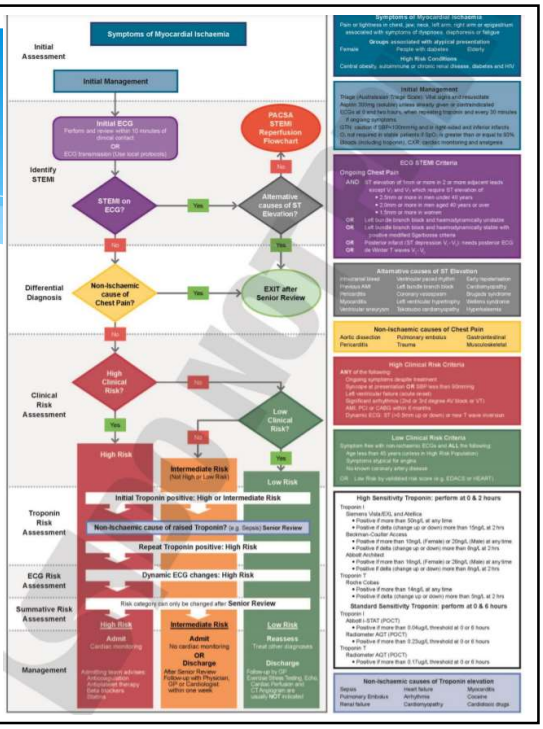
*referenced to average mortality (95% confidence intervals)

(BACK)

Grading Risk in a Patient Presenting With Chest Pain



Grading Risk in a Patient Presenting With Chest Pain

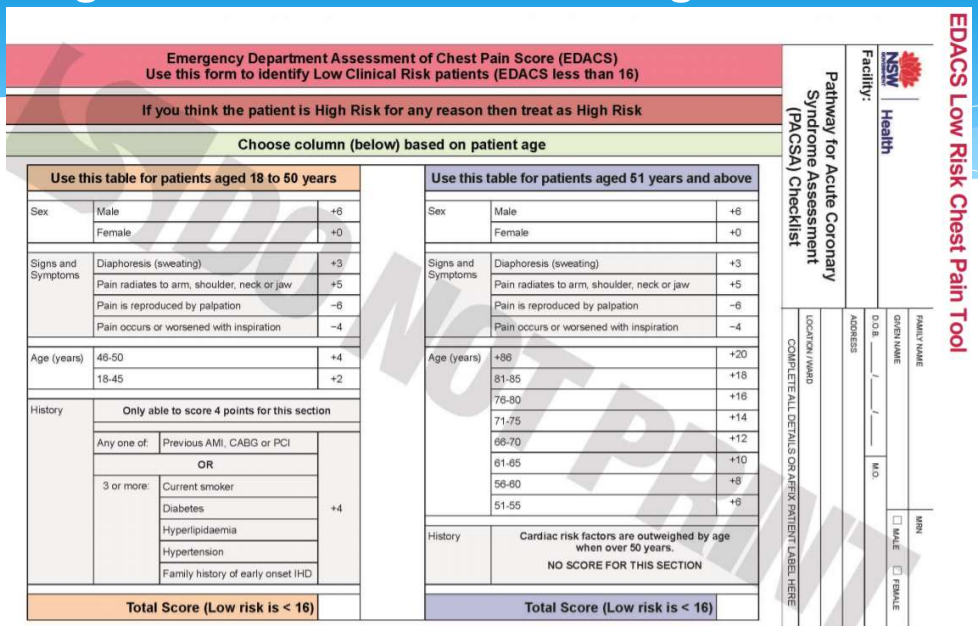


Grading Risk in a Patient Presenting With Chest Pain

If you think the patient is High Risk for any reason then treat as High Risk

Initial Assessment	☐ Triage category (Australasian Triage Scale). Vital signs and resuscitate		
	☐ Aspirin 300mg (soluble)	☐ already given	☐ contraindicated
	☐ ECGs at 0 and two hours, when repeating troponin and every 30 minutes if ongoing symptoms		
	☐ Bloods (and troponin), IV, monitoring, CXR, analgesia, +/- GTN, O_2 (if Sats <93%)		
Identify STEMI	☐ Perform and review initial ECG within 10 minutes of clinical contact		
	☐ ECG meets STEMI Criteria	Alternative causes of ST Elevation? **Senior Review**	**Go to PACSA STEMI Reperfusion Flowchart**
Clinical Risk Assessment	High ☐	Intermediate ☐	Low ☐ *See EDACS over page*
	If Non-Ischaemic cause of Chest Pain EXIT Flowchart and **Senior Review**		
Troponin Risk Assessment Initial	Positive ☐ Becomes either High or Intermediate Risk		Negative ☐ Low Risk
	If Non-Ischaemic cause of troponin elevation (e.g. Sepsis): **Senior Review**		
Repeat	Positive ☐ High Risk	Negative ☐ Intermediate Risk	Negative ☐ Low Risk
ECG Risk Assessment	Dynamic ECG ☐ High Risk	ECG unchanged ☐ Intermediate Risk	ECG unchanged ☐ Low Risk
Summative Risk Assessment	**High Risk** ☐	**Intermediate Risk** ☐	**Low Risk** ☐
Management	**Admit** Cardiac monitoring Admitting team advises: Anticoagulation Antiplatelet therapy Beta blockers Statins	**Admit** No cardiac monitoring **OR** **Discharge** After Senior Review Follow-up with Physician, GP or Cardiologist within one week	**Reassess** Treat other diagnoses **Discharge** Follow-up by GP Exercise Stress Testing, Echo, Cardiac Perfusion and CT Angiogram are usually **NOT** indicated

Grading Risk in a Patient Presenting With Chest Pain



Emergency Department Assessment of Chest Pain Score (EDACS)
Use this form to identify Low Clinical Risk patients (EDACS less than 16)

If you think the patient is High Risk for any reason then treat as High Risk

Choose column (below) based on patient age

Use this table for patients aged 18 to 50 years		
Sex	Male	+6
	Female	+0
Signs and Symptoms	Diaphoresis (sweating)	+3
	Pain radiates to arm, shoulder, neck or jaw	+5
	Pain is reproduced by palpation	−6
	Pain occurs or worsened with inspiration	−4
Age (years)	46-50	+4
	18-45	+2
History	Only able to score 4 points for this section	
	Any one of: Previous AMI, CABG or PCI	+4
	OR	
	3 or more: Current smoker, Diabetes, Hyperlipidaemia, Hypertension, Family history of early onset IHD	
Total Score (Low risk is < 16)		

Use this table for patients aged 51 years and above		
Sex	Male	+6
	Female	+0
Signs and Symptoms	Diaphoresis (sweating)	+3
	Pain radiates to arm, shoulder, neck or jaw	+5
	Pain is reproduced by palpation	−6
	Pain occurs or worsened with inspiration	−4
Age (years)	+86	+20
	81-85	+18
	76-80	+16
	71-75	+14
	66-70	+12
	61-65	+10
	56-60	+8
	51-55	+6
History	Cardiac risk factors are outweighed by age when over 50 years. NO SCORE FOR THIS SECTION	
Total Score (Low risk is < 16)		

Pathway for Acute Coronary Syndrome Assessment (PACSA) Checklist

Facility: NSW Health

FAMILY NAME
GIVEN NAME
D.O.B. ___/___/___
M/F
ADDRESS
LOCATION / WARD
MRN
☐ MALE ☐ FEMALE
COMPLETE ALL DETAILS OR AFFIX PATIENT LABEL HERE

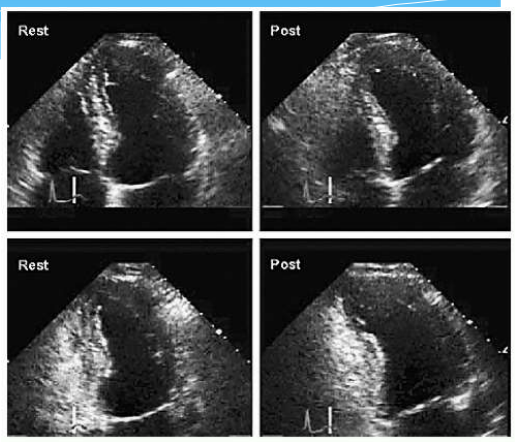
EDACS Low Risk Chest Pain Tool

Investigations in Low to Intermediate Risk Chest Pain

- There may also be other situations where exclusion of coronary ischaemia is needed, e.g. in heart failure, cardiomyopathy, and before surgery
- Patient setting and ease of arranging investigation may affect decision as well
- Functional testing versus anatomical testing
- Exclusion of ischaemia (diagnostic) versus risk prediction (prognostic)
- Consider patient-specific factors and potential contraindications to certain tests

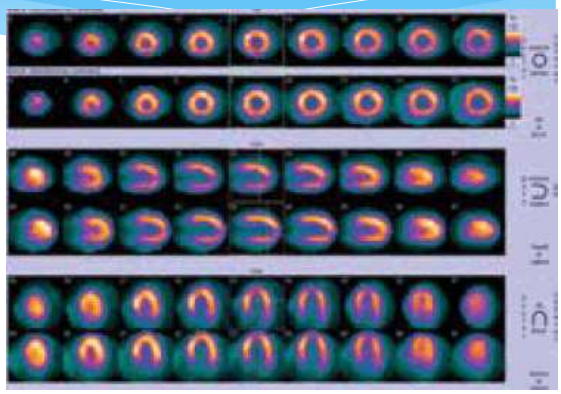
Stress Echocardiography

- What the test involves
  - Treadmill or bicycle exercise, ECGs, pre and post exercise echocardiography
  - Superior in sensitivity and specificity to stress ECG, which is rarely used in cardiology practices now
- Advantages
  - Good sensitivity and specificity
  - Information on patient symptoms and exercise capacity
  - 7 or more METs is indicative of a good surgical outcome
  - Functional information not provided by CTCA
  - Cost-effective and convenient
- Disadvantages
  - Exercise component (although dobutamine stress echocardiography may be used)
  - Operator and heart rate dependent
  - Does not detect non-haemodynamically significant coronary artery disease
  - Higher specificity that myocardial perfusion imaging



Myocardial Perfusion Imaging

- What the test involves
- Advantages
  - Can be performed without exercise
  - Information on left ventricular function
- Disadvantages
  - Impacted by body habitus
  - Balanced ischaemia
  - Diaphragmatic artefact
  - Does not detect non-haemodynamically significant coronary artery disease



CT Coronary Angiography

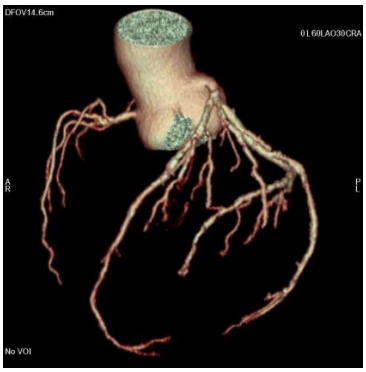
- MBS indications are:
  - Patient has stable symptoms consistent with coronary ischaemia, is at low to intermediate risk, and would have been considered for coronary angiography
  - Patient requires exclusion of coronary artery anomaly or fistula
  - Patient will undergo non-coronary cardiac surgery
- What the test involves
  - CT scan with IV contrast
  - Appropriate CT scanner, gating, and interpretation (software and reporter) are required (i.e. a radiology facility having a CT scanner is not synonymous with a radiology facility being able to perform a CTCA on a patient)

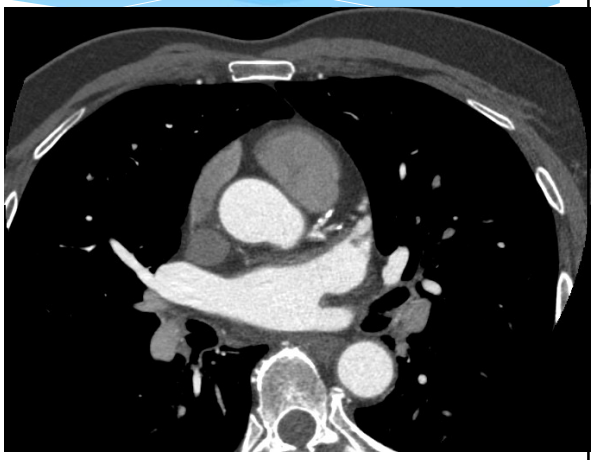
CT Coronary Angiography

- Advantages:
  - Diagnostic and prognostic data
  - Quick and useful for facilitating quick discharge of patients from hospital
  - Does not require exercise
  - High negative predictive value
  - Very good sensitivity with good specificity
- Disadvantages
  - Difficult in patients with a high burden of calcium
  - As it is not a functional test, assessment of haemodynamic significance of coronary lesions can sometimes be difficult
  - Contrast use in patients with renal impairment or iodine allergy
  - Heart rate dependent and requires good radiographers who are well-trained in this

Results of CT Coronary Angiography

- No coronary artery disease detected
- <50% stenosis
- 50-75% stenosis
- >75% stenosis





Other Uses for Cardiac CT Scanning

- Assessment of chest pain and other ischaemic symptoms
- Long term risk prediction
- Assessment of coronary arteries in patients undergoing non-coronary cardiac surgery
- Exclusion of coronary anomalies
- Assessment of patients with arrhythmias, heart failure, or cardiomyopathy
- Transplant patients
- Assessment prior to ablation
- Assessment for non-surgical valve procedures

Case Study

- History
  - 64 yo gentleman without any cardiac symptoms
  - Referred by his ophthalmologist because of a recent episode of transient visual loss
  - Suddenly developed blurred vision in right eye, followed by transient loss of part of visual field for a few hours, before spontaneously subsiding
  - Normal CT brain and carotid duplex ultrasound, but CT angiogram showed a short segment of moderate grade stenosis of the proximal right vertebral artery with mild post-stenotic dilatation

Case Study

- Background
  - Normal weight, but diet is a vegetarian diet relatively high in carbohydrates
  - Exercises regularly by walking or using rowing machine (has noticed a mild reduction in his ability on the rowing machine recently)
  - Latent autoimmune diabetes in adults (LADA) diagnosed in 2007
  - Non-smoker
  - Denies any family history of ischaemic heart disease
  - Recent blood tests: total cholesterol 4.5mmol/L, LDL 2.9mmol/L, fasting glucose 9.5mmol/L, HbA1c 9.9%
  - 10 year ASCVD risk = 16.7% (intermediate risk)
  - CVD risk assessment based on Framingham risk score = >15% (high-risk)

Case Study

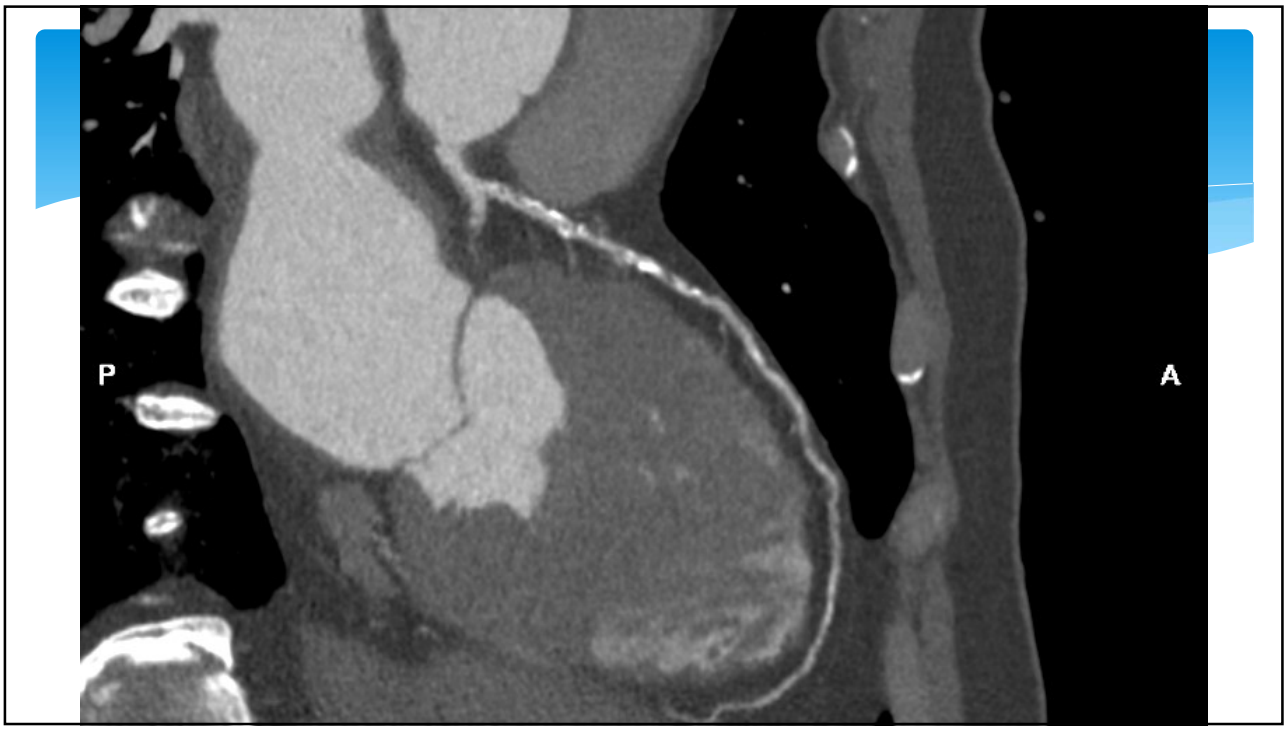
- Medications
  - Janumet XR 100mg/1000mg daily
  - Lantus 15 units before bed
  - NovoRapid 5 units tds
  - Ostelin 1000 units daily

Case Study

- Investigations
  - 12 lead ECG: normal sinus rhythm at 56bpm
  - Stress echocardiogram:
    - ECG: horizontal ST depression in the inferior leads (3mm deep)
    - Echo: normal

Case Study

- Investigations
  - CTCA:
    - Calcium score: 602 (95th percentile)
    - LMCA: 25-49% stenosis
    - LAD: >70% stenosis in proximal, mid, and distal vessel
    - Intermediate artery: >70% stenosis
    - LCX: dominant vessel, 25-49% stenosis; >70% stenosis of the second obtuse marginal branch
    - RCA: non-dominant vessel, 25-49% stenosis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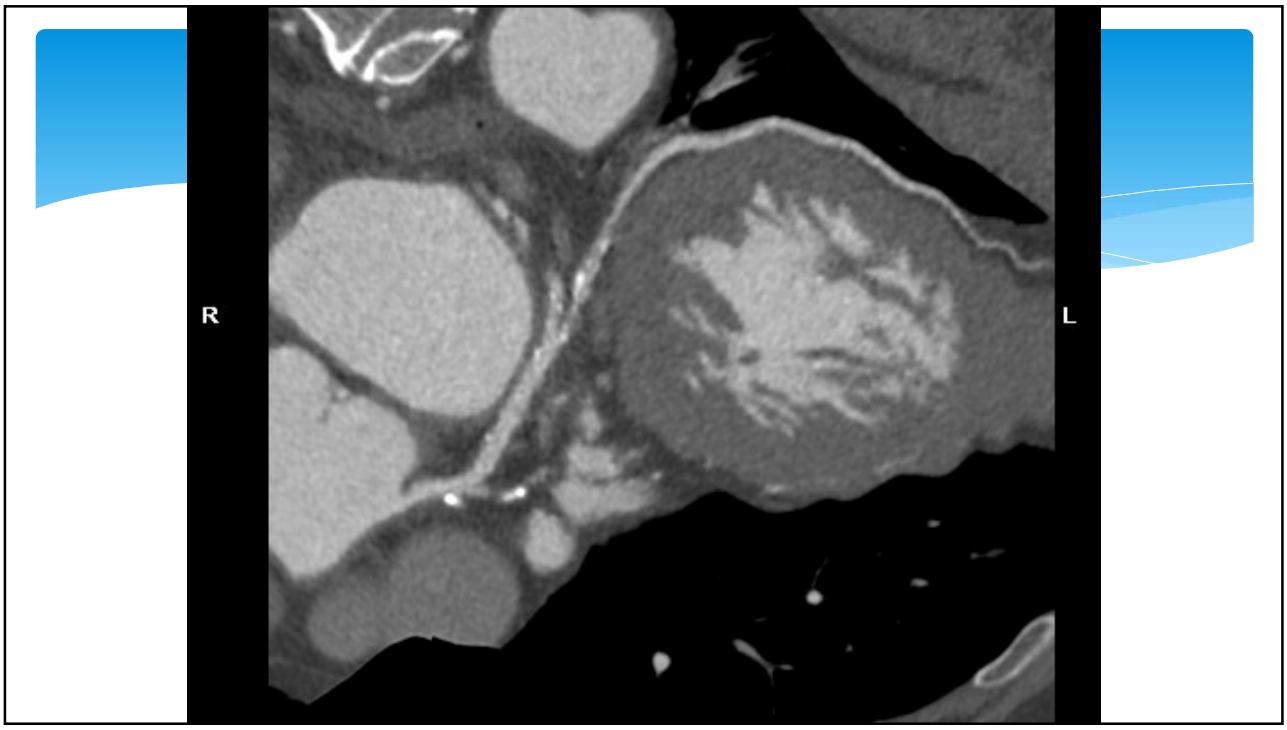
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Case Study

- Coronary angiogram
  - The LAD was moderate-severely diffusely diseased from the ostium to the mid vessel with 80% stenosis in mid vessel. There was a segment in the mid-distal vessel of several cm in length which was relatively free of disease and could be grafted.
  - Two small diagonals had >75% stenosis at ostium and were not graftable.
  - Intermediate artery had 40-50% narrowings.
  - The left circumflex system was dominant. OM1 was small and had mild disease. OM2 had 70-80% stenosis and was graftable. PL branch was small and tightly stenosed and not graftable. PDA branch had proximal 50% stenoses and diffuse distal disease and was possibly graftable.
  - The right coronary artery was small and occluded proximally giving rise to a RV branch.

Case Study

- Progress
  - Commenced on aspirin and rosuvastatin after abnormal stress echocardiogram
  - Referred for coronary artery bypass grafting after coronary angiogram

Summary

- Cardiovascular risk assessment should be part of routine practice in general practice and cardiology practice
- CT calcium scoring can be a useful adjunct to cardiovascular risk assessment in certain patients
- CT coronary angiography provides useful information regarding cause of chest pain, cardiovascular risk, and cardiac (including coronary) anatomy
- Stress echocardiography and CT coronary angiography are often useful investigations in patients with low to intermediate risk chest pain

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- Up to Date: Noninvasive testing and imaging for diagnosis in patients at low to intermediate risk for acute coronary syndrome
- Up to Date: Selecting the optimal cardiac stress test
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