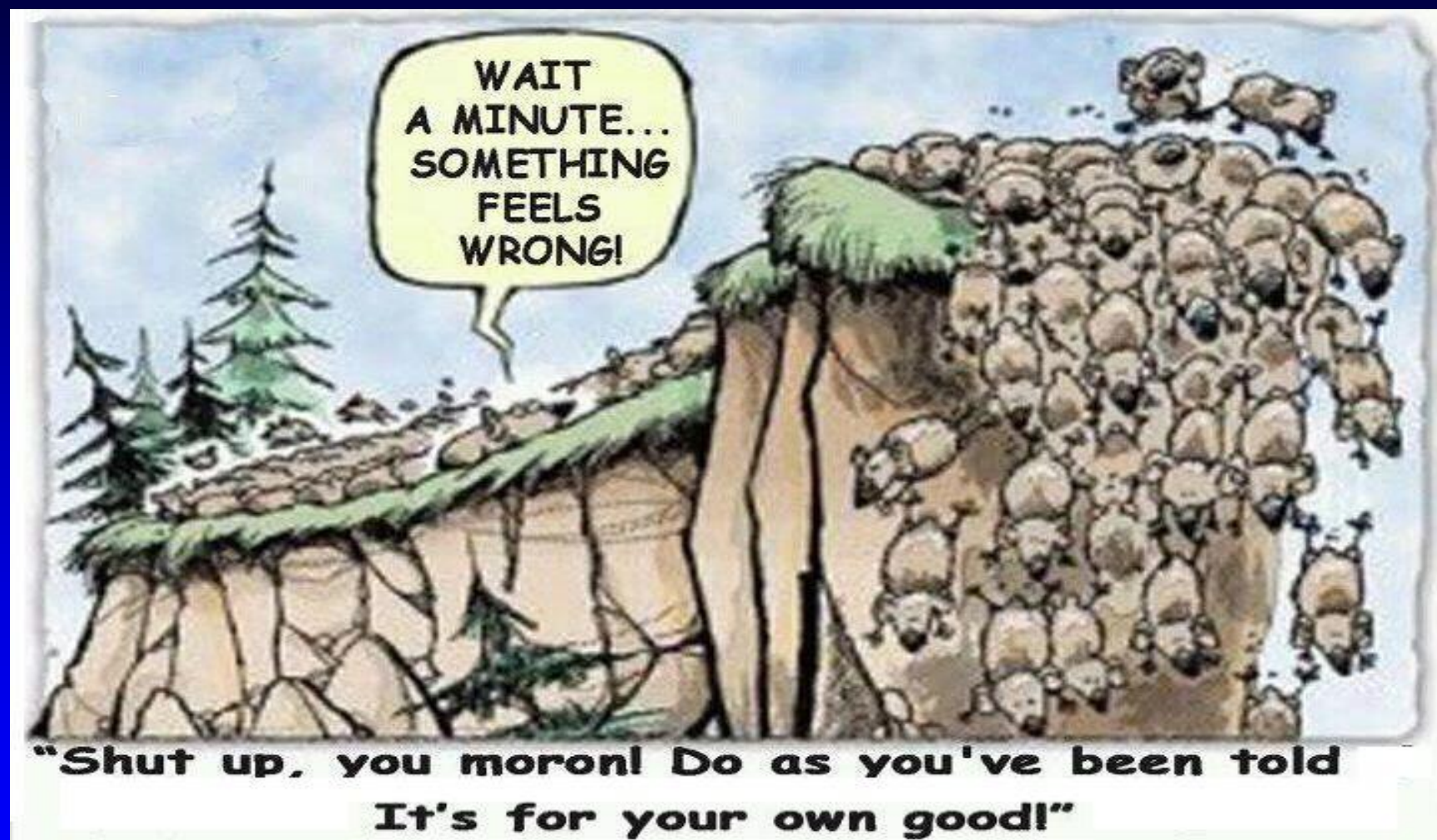


Perioperative involvement of the cardiologist

Dr Kiran Patel

Consultant Cardiologist, Heart of England Trust &
Medical Director, NHS England (West Midlands)



Outline

- Preoperatively: who needs to be seen?
 - Cardiac patients
 - Non-cardiac patients post/for risk stratification
- Perioperative issues:

By 2035

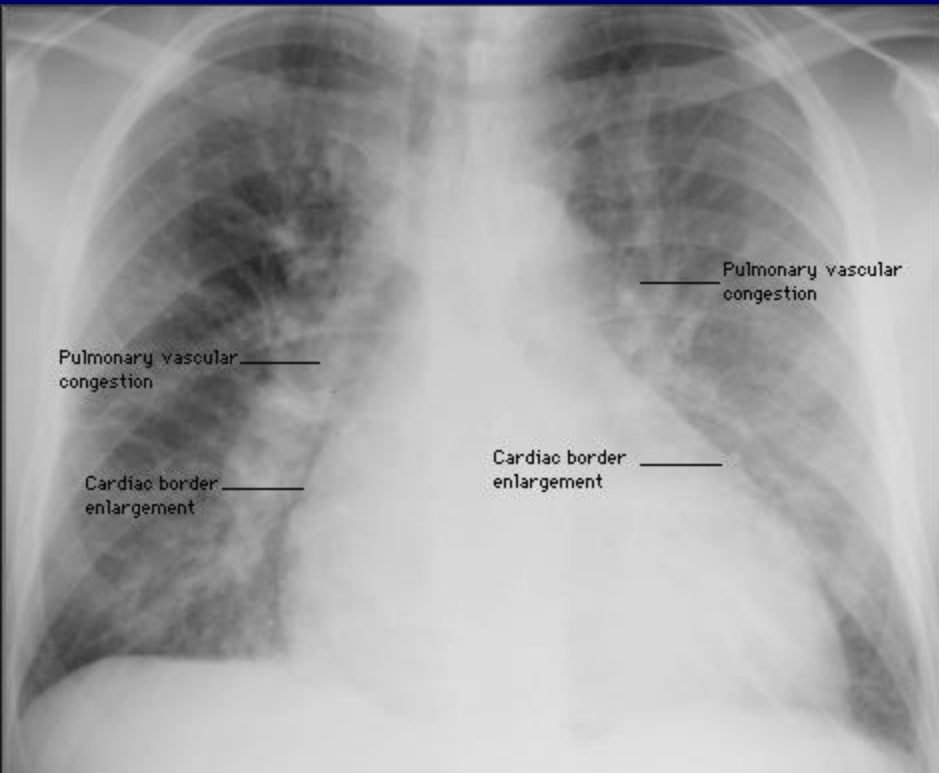
- 25% more operations in Europe
- 50% more elderly people
- More obesity & DM

The Shopping Galleries The Offices

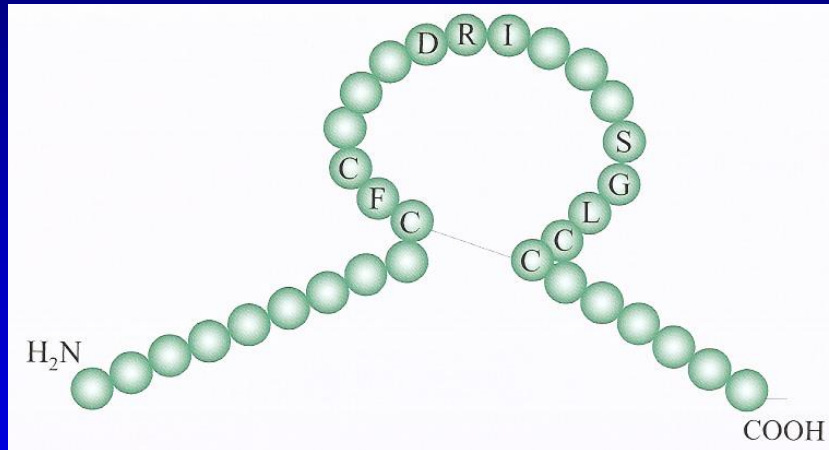
The Shopping Galleries The Offices



Heart Failure?



BNP



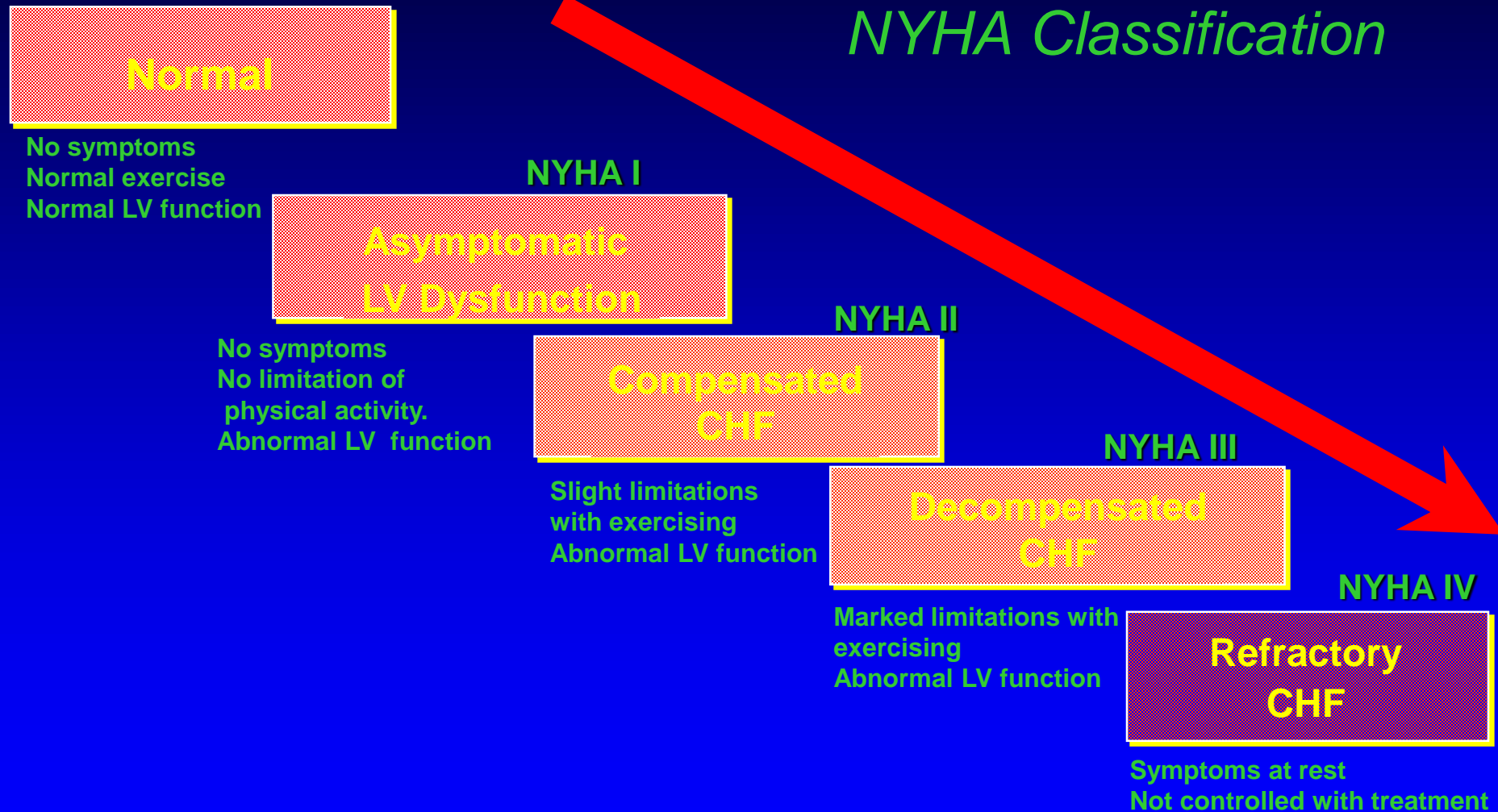
Mortality statistics for HF

- 40% die within 1 year of diagnosis
- 10% pa mortality thereafter
- Mortality rates globally predicted to ↑ 115-127% from 1990-2020 – mainly in S Asia

	NYHA II	NYHA III	NYHA IV
CHF	12	26	56
Other	24	15	11
SCD	64	59	33
1 yr mortality	3-25%	10-45%	50-80%

Diagnosis of Congestive Heart Failure

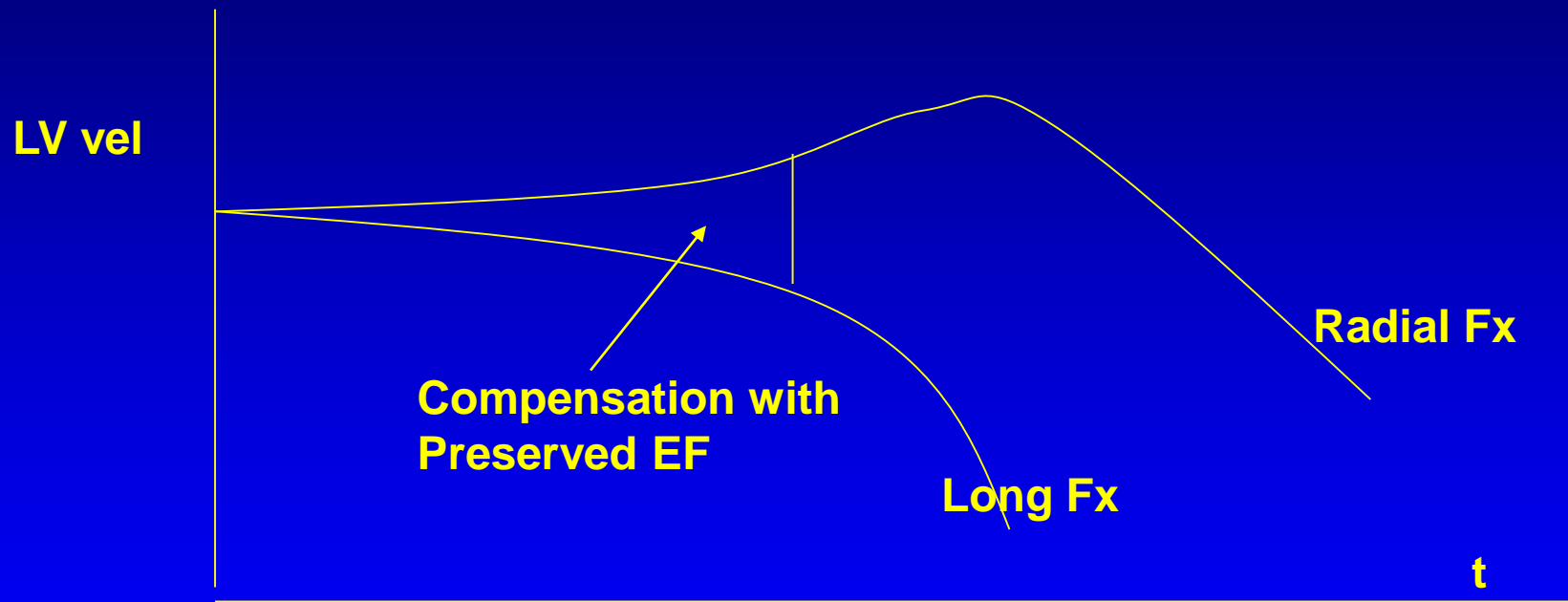
NYHA Classification



Is screening for LVSD enough?

- 30-50% of HF patients have no LVSD
 - LVDD (Moller et al, EJHF 2003)
 - Valvopathy
 - Arrhythmias
- 30% of post-MI patients develop symptoms of HF after index event 80% of post-MI deaths occur in this group
- TRACE
 - 40% of post-MI patients had LVSD
 - 30% had symptomatic HF and LVSD
 - 66% had either LVSD or symptoms of HF

LVDD



LVEF and NYHA

- No correlation – why not?
 - Prevalence of asymptomatic LVSD similar to symptomatic LVSD (McDonagh et al, Lancet 1997)
- EF dependent upon
 - Preload
 - Afterload
 - Chronotropy
 - Inotropy
- Rate of fall in EF correlated with prognosis

Aetiology

- Cardiac
 - Ischaemic (65%)
 - HT
 - Valvular
 - Arrhythmic
 - Pericardial
- HOCF
 - Pregnancy
 - Pagets etc.
- Systemic
 - Vasculitis
 - Infection
 - Chagas, viral
 - Genetic
 - HCM, DCM, DMD
 - Metabolic
 - DM, amyloid, sarcoid, storage disorders
 - Toxic
 - EtOH, drugs, Fe overload

Differential diagnosis

- Lung disease
- Obesity
- Mechanical
 - chest wall or diaphragm abnormalities
- Fluid retention
 - Drug induced
 - Venous insufficiency
- Renal failure
- Liver failure
- Hypoalbuminaemia
- PE
- Anaemia
- Thyroid disease
- Deconditioning
- Depression/anxiety

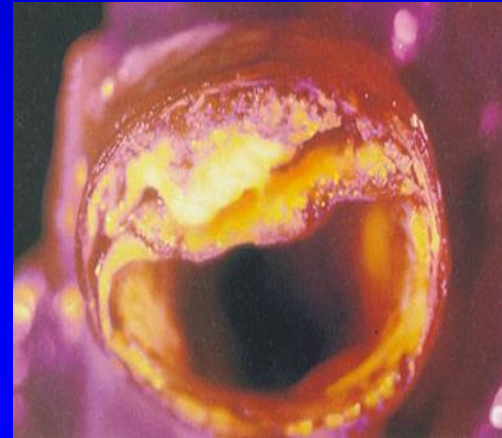
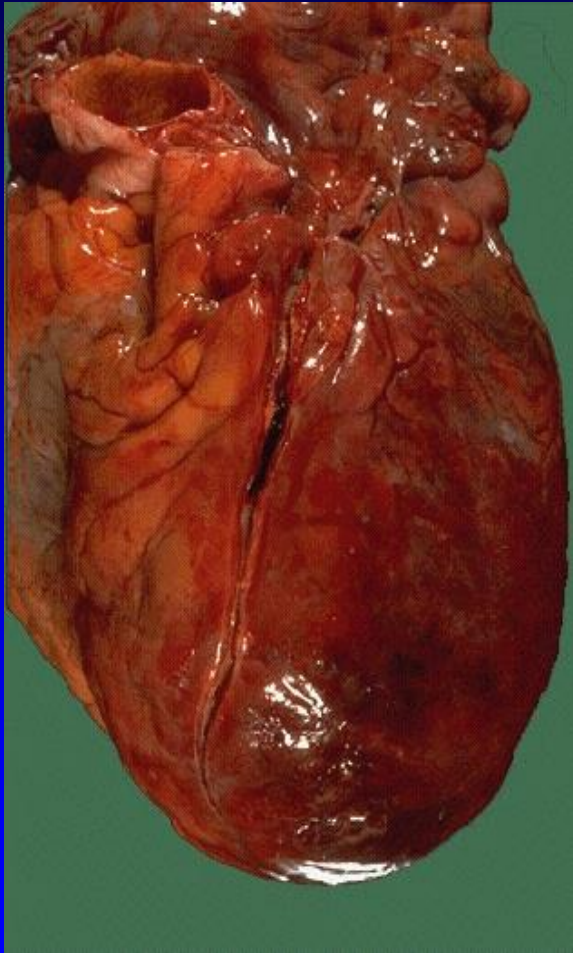
Precipitants of decompensation

- ACS: Angina/MI
- Arrhythmia
- Valvopathy deterioration
- Myocarditis
- Tamponade
- Dissection
- Shunts
- HT crisis
- Anaemia
- Alcohol
- Infection
- Iatrogenic – XS fluids, drugs
- Pregnancy
- PE
- Thyroid disease
- Brain injury
- Renal failure
- Asthma
- Drug abuse

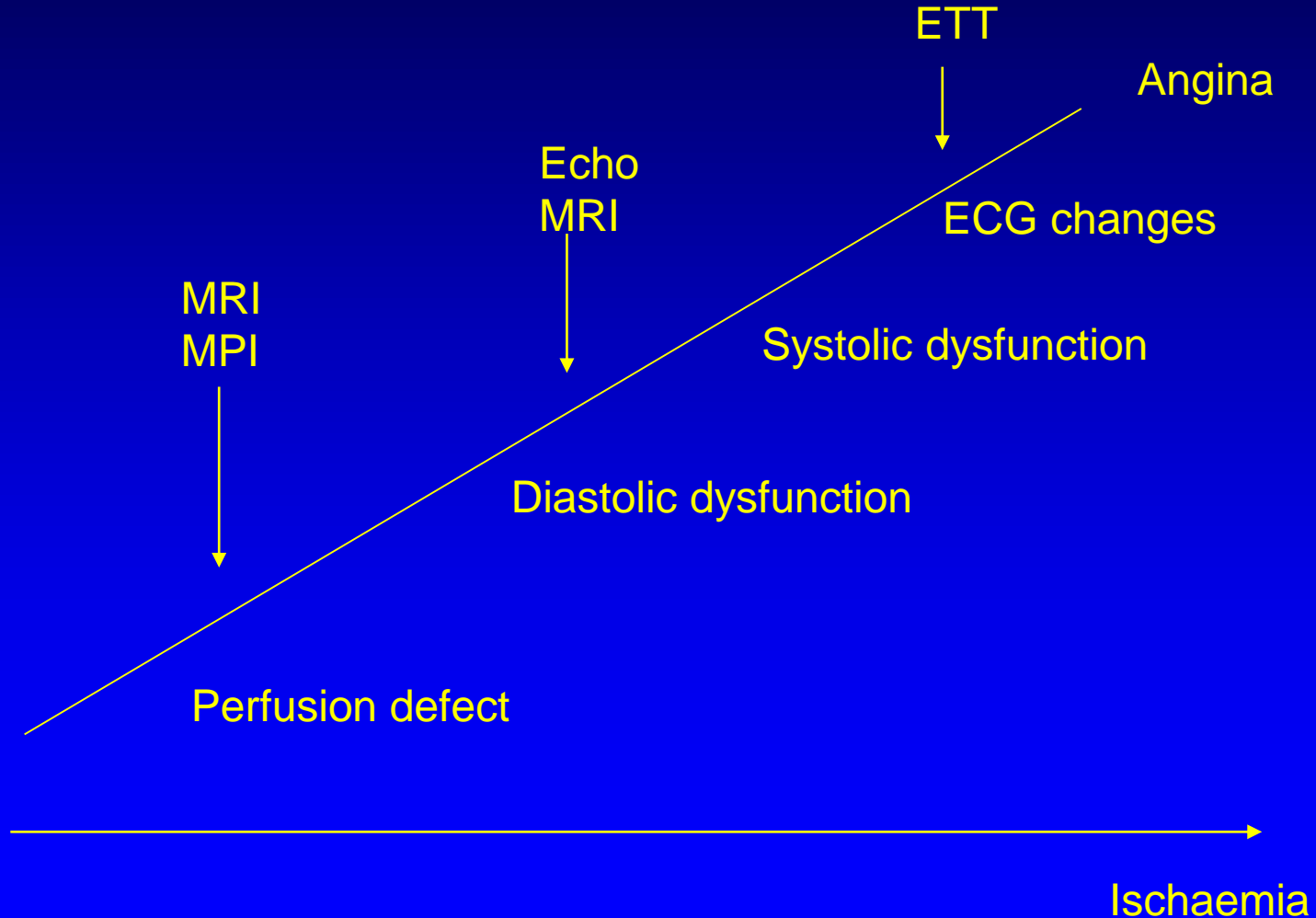
HF therapy menu

- Starters
 - Diuretics
 - Rehabilitation
- Main course
 - ACEI
 - β blockers
 - Spironolactone
 - Eplerenone
 - ARB
 - Digoxin
 - Levosimendan
- Dessert
 - CRT
 - ICD
- Coffee (not hungry)
 - High risk surgery
- After dinner mints (still hungry?)
 - Transplantation
 - VAD – bridge or destination
- Carriages
 - Palliative care
 - EECp
 - Sleep disordered breathing
 - Plasmapheresis
- Reincarnation/after-life
 - Gene therapy
 - Stem cells
 - Nesiritide
 - rEPO or iv Fe
 - Myosin activators

Coronary heart disease patients



Ischaemic cascade

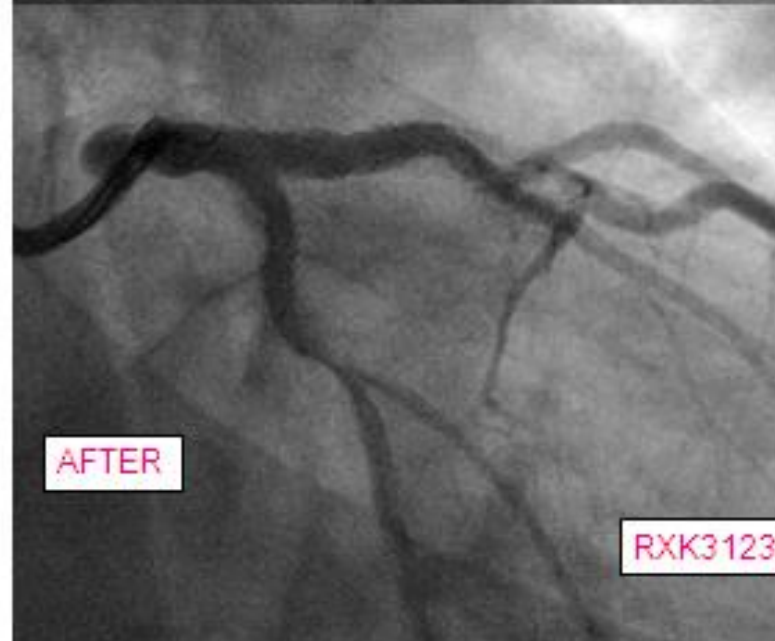
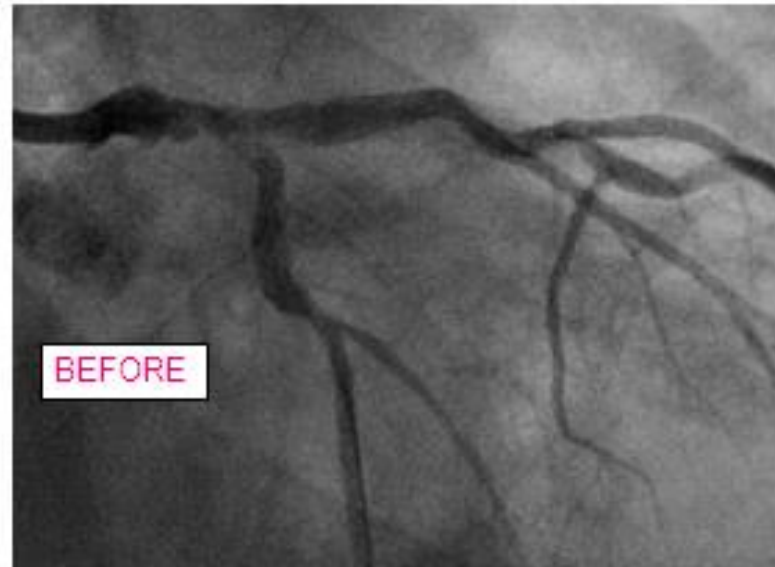


Diagnostic tools

	Sensitivity	Specificity
ETT	78%	70%
DSE	81%	80%
MPI	90%	71%

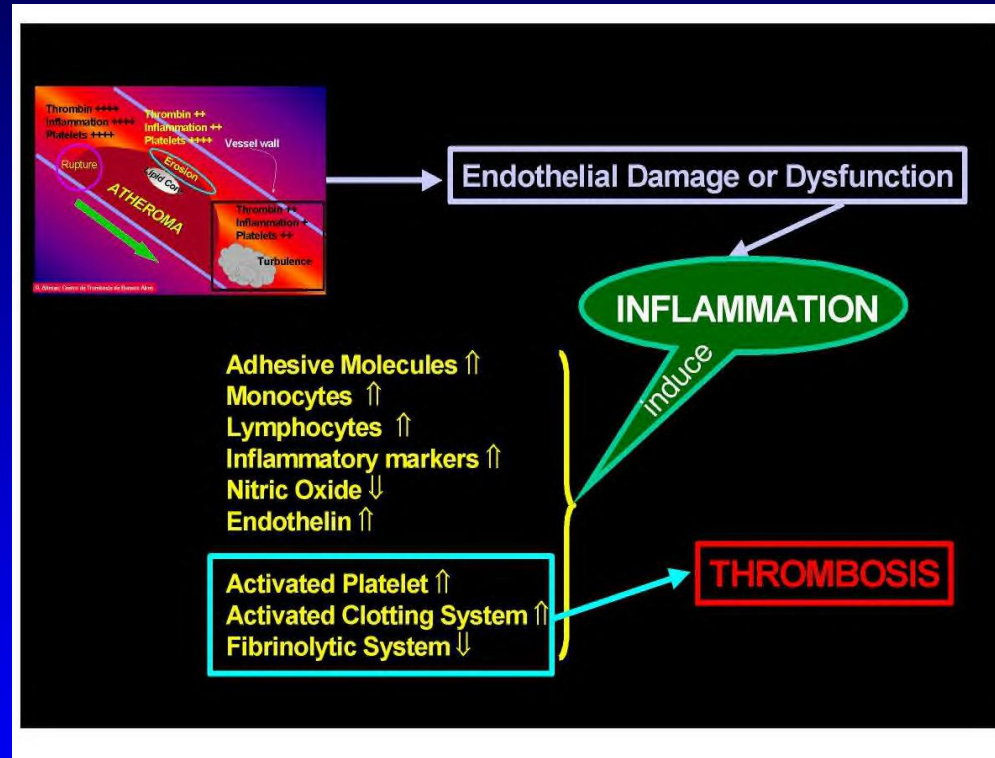
Non invasive angiography

- Limited by spatial and temporal resolution
- MRI
- CTCA
 - High radiation dose
 - Limited in pregnancy and renal failure
- Ca scoring
 - High -ve predictive value: 99.4% 5 yr survival if 0% in non diabetics (Raggi et al, JACC 2004)



What causes the perioperative cardiac event?

- 50% plaque rupture
- 50% myocardial oxygen demand/supply problem

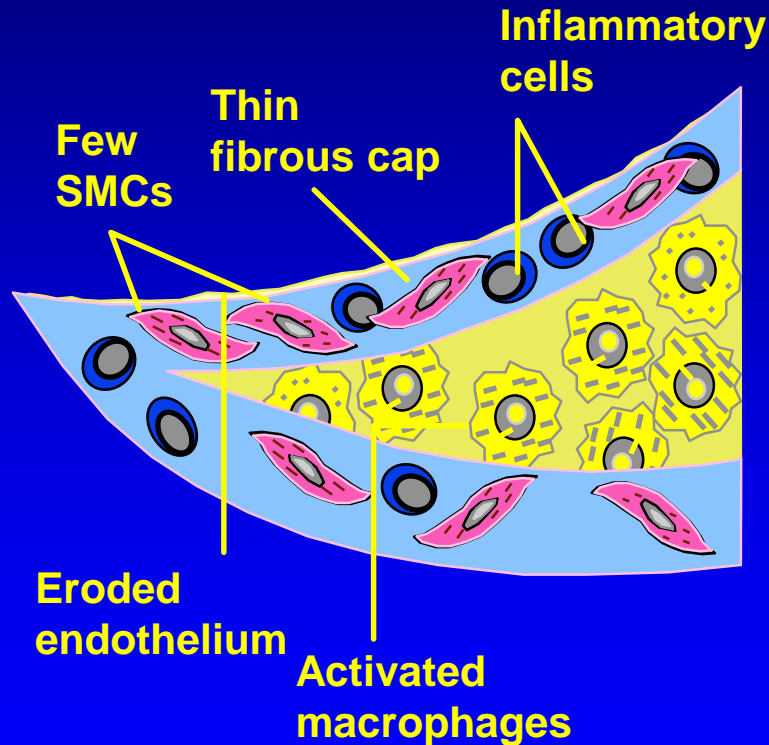


Pathophysiology of perioperative MI

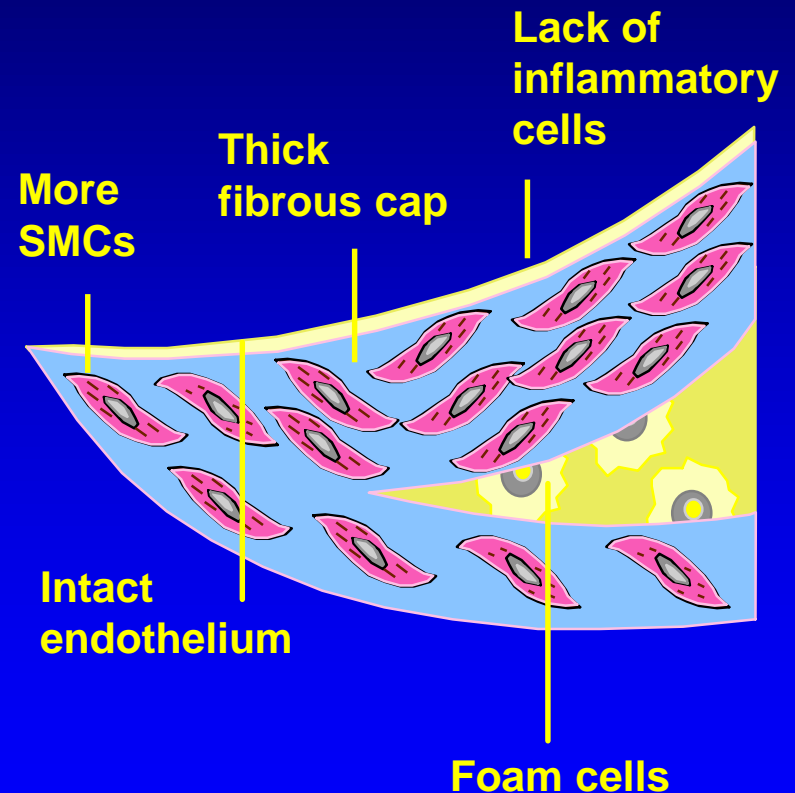
- ↑ neurohormonal activation
- ↑ shear stress
- ↑ platelet activation
- ↑ coronary spasm
- ↑ catecholamines
- ↓ endogenous tPA
- Supply-Demand imbalance
 - Post-operative pain
 - Fluid shifts

Characteristics of Unstable and Stable Plaque

Unstable



Stable



Perioperative events: The Q

- Not
 - Who needs Ix?
 - » Ix may precipitate a cascade of events of revascularisation when not indicated to reduce risk
- BUT
 - Who is at risk and what is that risk?
 - What causes perioperative events?
 - How can we reduce them?
 - Would cardiac referral be indicated in its own right?

Surgical Risk by Intervention

Low-risk: < 1%	Intermediate-risk: 1-5%	High-risk: > 5%
<ul style="list-style-type: none"> • Superficial surgery • Breast • Dental • Endocrine: thyroid • Eye • Reconstructive • Carotid asymptomatic (CEA or CAS) • Gynaecology: minor • Orthopaedic: minor (meniscectomy) • Urological: minor (transurethral resection of the prostate) 	<ul style="list-style-type: none"> • Intraperitoneal: splenectomy, hiatal hernia repair, cholecystectomy • Carotid symptomatic (CEA or CAS) • Peripheral arterial angioplasty • Endovascular aneurysm repair • Head and neck surgery • Neurological or orthopaedic: major (hip and spine surgery) • Urological or gynaecological: major • Renal transplant • Intra-thoracic: non-major 	<ul style="list-style-type: none"> • Aortic and major vascular surgery • Open lower limb revascularization or amputation or thromboembolectomy • Duodeno-pancreatic surgery • Liver resection, bile duct surgery • Oesophagectomy • Repair of perforated bowel • Adrenal resection • Total cystectomy • Pneumonectomy • Pulmonary or liver transplant

Fitness for surgery: Revised Cardiac Risk Index

- Factor
 - High risk surgery**
 - IHD*
 - CCF
 - Cerebrovascular disease
 - IDDM
 - Cr>152

*asymptomatic prior CABG or PCI
excluded

**intraperitoneal, intrathoracic, supra-
inguinal vascular

No of factors	CV
0	0.4%
1	1.1%
2	4.6%
>3	9.7%

Lee et al, Circulation 1999

Revised Cardiac Risk Index (RCRI)

MACE rate*

No of Variables (RCRI Class)	Derivation Cohort % (no)	Validation Cohort % (no)
0 (Class I)	0.5 (5/1071)	0.4 (2/488)
1 (Class II)	1.3 (14/1106)	0.9 (5/567)
2 (Class III)	4.0 (18/506)	7.0 (12/258)
3 or more (Class IV)	9.0 (19/210)	11.0 (12/109)

*AMI, pulmonary oedema, VF, primary cardiac arrest, 3rd heart block

Fitness for surgery: NSQIP (Gupta) Scoring system (2011)

Risk of MI or cardiac arrest (developed as RCRI suggested to have poor discriminator ability)

ASA status

- ASA 1 = Normal healthy patient
- ASA 2 = Mild systemic disease
- ASA 3 = Severe systemic disease
- ASA 4 = Severe systemic disease that is a constant threat to life
- ASA 5 = Moribund patients who are not expected to survive without the operation

5 Variables

- ASA status
- Age
- Creatinine (133 or ?)
- Functional (independent/partially or totally dependent)
- Procedure

Markers of increased CV risk

- Angina
- HF
- Previous MI
- DM
- CRF
- Poor functional capacity - frailty
- High risk surgery

Clinical Predictors ACC/AHA

Minor	Intermediate	Major
<ul style="list-style-type: none">•Advanced age•Abnormal ECG•Rhythm not sinus•Poor functional capacity•History of CVA•High BP	<ul style="list-style-type: none">•Mild angina•Prior MI•CCF (ever)•DM	<ul style="list-style-type: none">•Unstable angina•Decomp CCF•Significant arrhythmia•Severe valve disease

Low risk surgery

- <1% risk
 - Orthopaedic (*some is v high risk)
 - Breast
 - Urology
 - Skin
- Does not require revascularisation prior to surgery as mortality risk remains <1% despite prior revascularisation

Assessing CV risk for non cardiac surgery

- >50% of patients with fatal MI after non cardiac surgery shown to have unstable coronary plaques
- Preoperative ETT or DSE does not simulate the adrenergic stress of surgery
- Perioperative MI associated with LMS and 3VD

Can Cardiac Drugs reduce Perioperative CV risk?

- **Atenolol**
 - given preoperatively and continued during hospitalisation reduces mortality compared to placebo
 - Benefits sustained for up to 2 years
- **Bisoprolol**
 - DECREASE trial in patients undergoing vascular surgery*
 - Reduction in death and non fatal MI
- **Statins**
 - No large scale trial yet but plaque stabilisation useful in PCI, CABG etc.
- **ACEI, antiplatelet agents etc: no trial evidence**

Perioperative Risk Modification

Perioperative β blockade

- Improved myocardial oxygenation (-vely inotropic and chronotropic)
- Antiinflammatory
- 16 fewer non fatal MIs per 1000 patients treated BUT at expense of 3 strokes and 3 deaths (Bangalore et al, metaanalysis Lancet Dec 2008)

Betablocker evidence

Poldermans et al NEJM 1999

- N= 112 with 1 or more cardiac risk factors and a positive stress echo
- Vascular surgery
- Bisoprolol 5-10 mg versus placebo
- Cardiovascular death @ 30 days:
- 3.4% bisoprolol v 17% placebo

Poldermans et al NEJM 1999

- RCRI Class I or II and positive stress echo on betablockers had risk similar to those with negative stress echo
- But risk posed by significant ischaemia* not really modified by betablockers

*Class III and IV angina

Perioperative β blockade

- Mangano et al
 - RCT of 200 patients
 - No mortality benefit of atenolol 50-100 mg iv given 30 minutes before surgery then orally throughout hospitalisation BUT 50% reduction in ischaemia
- DIPOM
 - 921 DM patients undergoing non-cardiac surgery
 - No benefit of metoprolol
- DECREASE study - discredited
 - 112 patients undergoing vascular surgery
 - 90% reduction in mortality for patients given bisoprolol 30 days preoperatively

Perioperative Beta blockade

- Removing discredited DECREASE studies demonstrates increased risk of
 - Mortality
 - Stroke
 - Hypotension

Perioperative β blockade

- POISE

- 100mg metoprolol preop and post op then for 30 days
- Higher death rate and stroke rate with BB

- COMMIT

- Post MI study
- Higher shock and mortality with metoprolol post MI

Perioperative β blockade

- 782 000 patients studied
- 122 000 received β blockers – timing variable
- Revised cardiac risk index (1 point for each of the following)
 - High risk surgery
 - IHD
 - Cerebrovascular disease
 - Renal insufficiency
 - DM

Perioperative β blockade

RCRI	Outcome with β blockade
0	No benefit, possible harm
1	No benefit, possible harm
2	0.88 (0.80-0.98) OR
3	0.71 (0.63-0.80) OR
4	0.58 (0.50-0.67) OR

Perioperative β blockade

- Meta-analysis of 22 trials
 - NNT – no clear benefit of metoprolol but benefit seen with atenolol in elderly
 - Devereaux et al, BMJ 2005
- Meta-analysis of 5 trials
 - NNT = 3-8
 - Auerbach and Goldman, JAMA 2002
- Meta-analysis of 11 trials
 - NNT = 32
 - Stevens et al 2004

Perioperative statins

- 3 studies show reduction in M&M in patients undergoing vascular surgery
 - O'Neil-Callahan et al, 2005
 - Kertai et al 2004
 - DECREASE III (2008)
- Pleiotropic effect –plaque stabilisation likely to explain mechanism of reduced perioperative MI/ACS

Perioperative β blockade

- Long acting β blockers better e.g. atenolol
- Short acting β blockers prone to higher risk of cardiac events upon withdrawal or missed doses of drug
- Use BB in those already established on it or where there is another indication

Coronary disease?

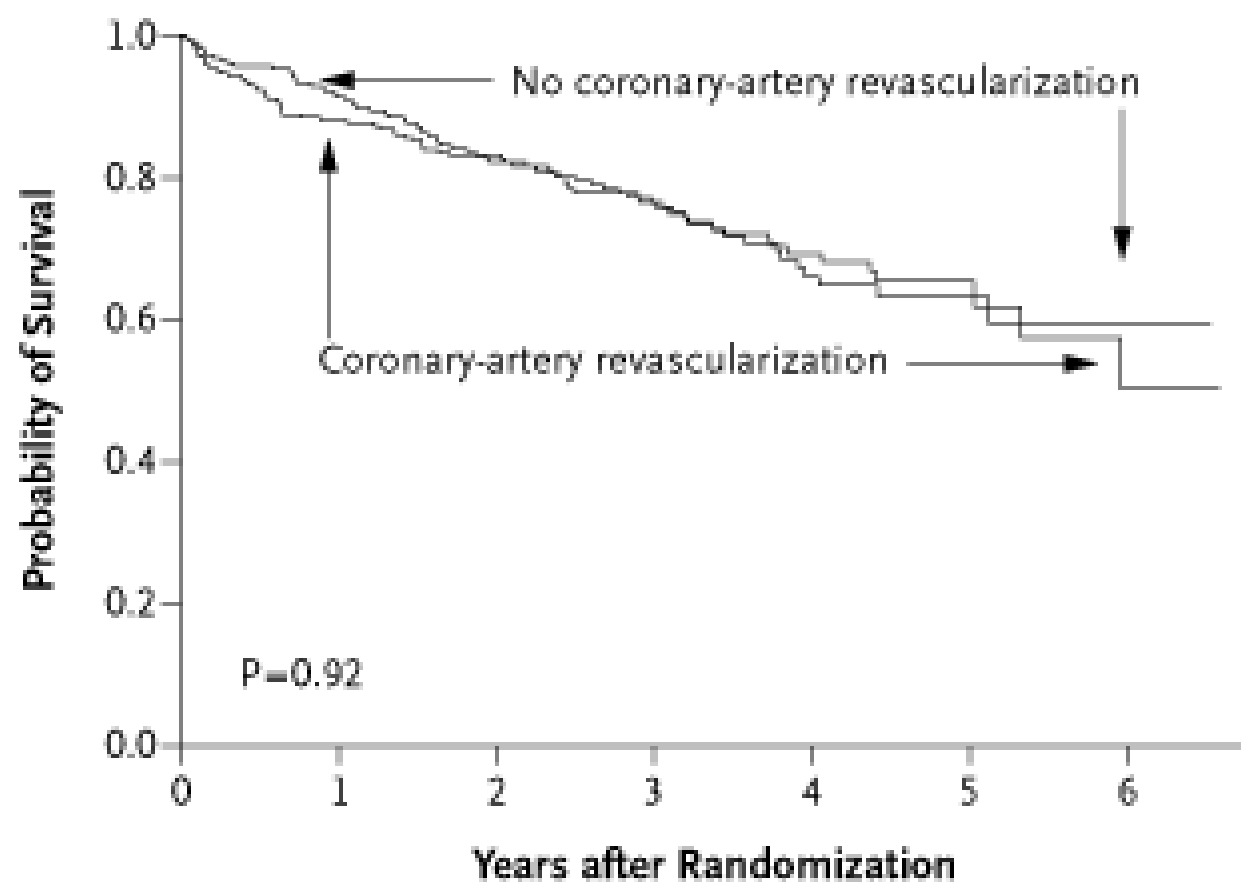
Revascularise first? CASS Registry

- Patients with previous CABG do have 50-70% lower perioperative risk for non-cardiac surgery
- However, factoring in the risk of CABG produces an overall higher risk for the non-cardiac surgery
- CABG therefore must be indicated in its own right on grounds of symptoms or prognosis

Prophylactic revascularisation

- No benefit of coronary revascularisation in stable CHD patients prior to elective surgery (*McFalls et al, NEJM 2004*)
- CTCA preoperatively does not improve overall net risk classification (*Sheth et al, 2015*)
- Most studies exclude patients with
 - LMS stenosis >50%
 - unstable coronary disease
 - severe AS
 - LVEF<20%

⇒ if these can be excluded, no revascularisation required
- No difference in CHD event rates or mortality seen



No. at Risk

Revascularization	226	175	113	65	18	7
No revascularization	229	172	108	55	17	12

Evidence for fixing...

Mason (1995) USA

Planned **vascular** surgery & positive MPS

Group A: proceed to surgery

Group B: cardiac cath and revascularise.

Cancel those with inoperable CAD

Group C: same as B but operate on the inoperable CAD group

Mason - results

End points: Mortality, non-fatal MI, stroke

Overall:

Group A (surgery no angio) did best

BUT

if risk of vascular surgery high – then pre-op angiography (and treatment) did have slightly lower mortality

Percutaneous intervention

PCI Preoperatively?

- PCI preoperatively is likely to be harmful
- Not evaluated
- Higher adverse event rates if performed within 90 days of non-cardiac surgery (Posner et al, 1999)
 - Bleeding
 - Stent thrombosis
 - Death
 - Non-fatal MI

Any surgery with 40 days PCI

Kaluza (2000)

N = 40; observational; mean 13/7 post PCI

MI	7
Major Bleeds	11
Deaths	8

MI and DEATH = STENT THROMBOSIS
(all occurred within 14/7 of PCI)

Drug Eluting Stents

No data post surgery

But:

McFadden (2005)

Early stent thrombosis = 1%

Late thrombosis = 0.35% (8/1993)

NONE on dual therapy;
can occur if stable on aspirin monotherapy

NB BMS= DES

CYPHER = TAXUS

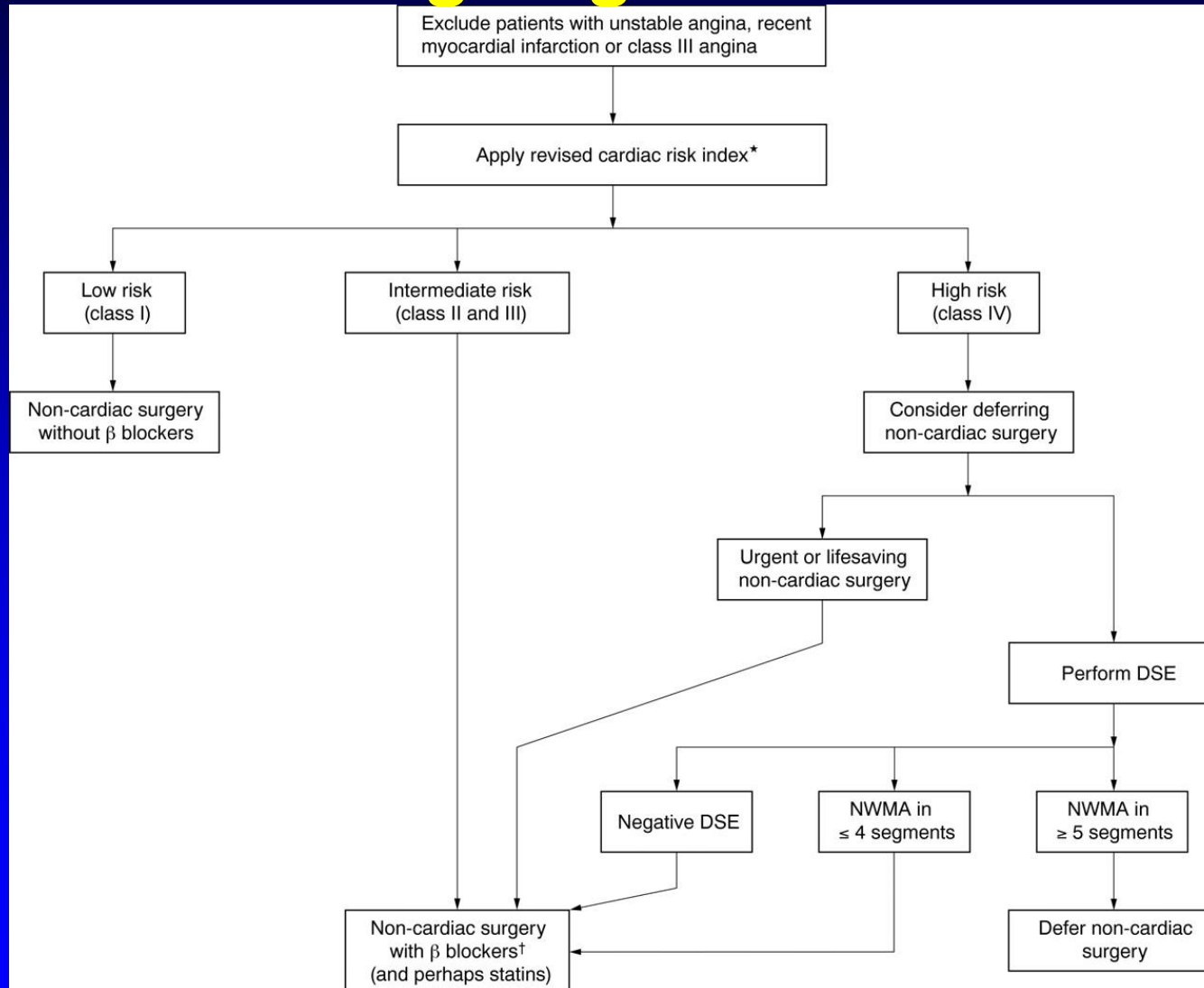
Dual antiplatelet Rx and non cardiac Sx

- Risk of SAT increased
 - Surgery is prothrombotic
 - Stopping clopidogrel 5 days prior in elective Sx
- Minimise risk
 - Stop clopidogrel for 5 days prior only
 - Restart clopidogrel 300mg post op
 - Continue aspirin

CAD: To fix or not?: In general 'Fix at your Peril'

- Negative tests are highly predictive of good outcome
- Positive tests are a very poor predictor of poor outcome.....and furthermore, overall event rates are higher in the 'fixed' population
- However, high risk patients may benefit from strategy of prior coronary revascularisation indicated in its own right

Proposed algorithm for the management of patients undergoing non-cardiac surgery.



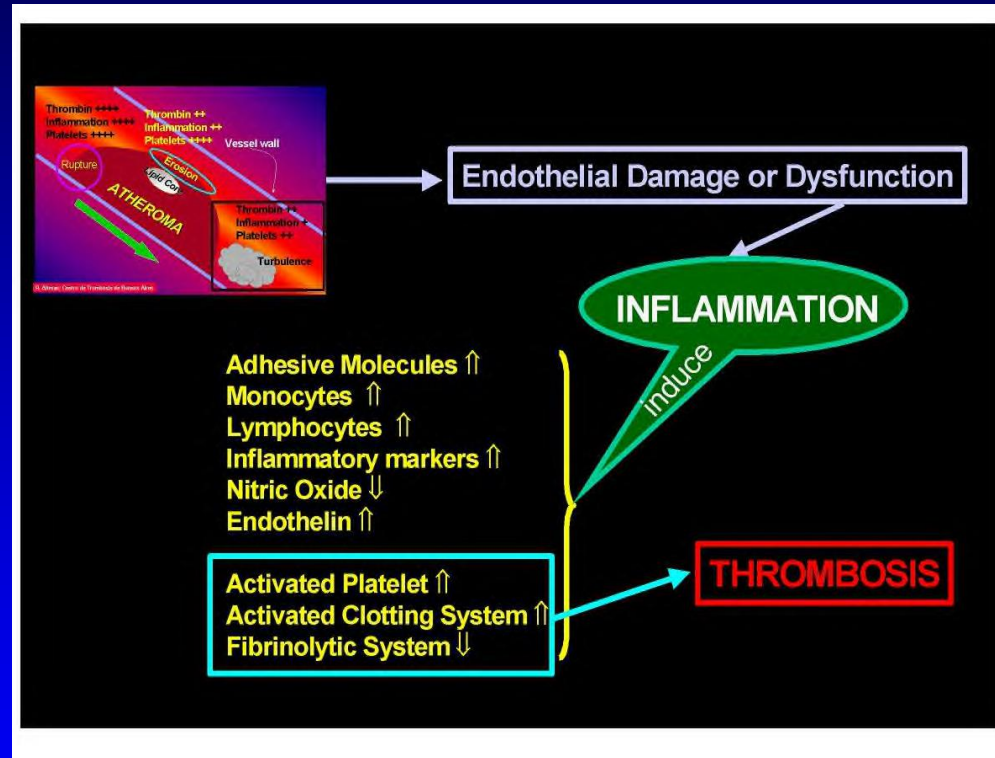
Statins and Plaque Stability

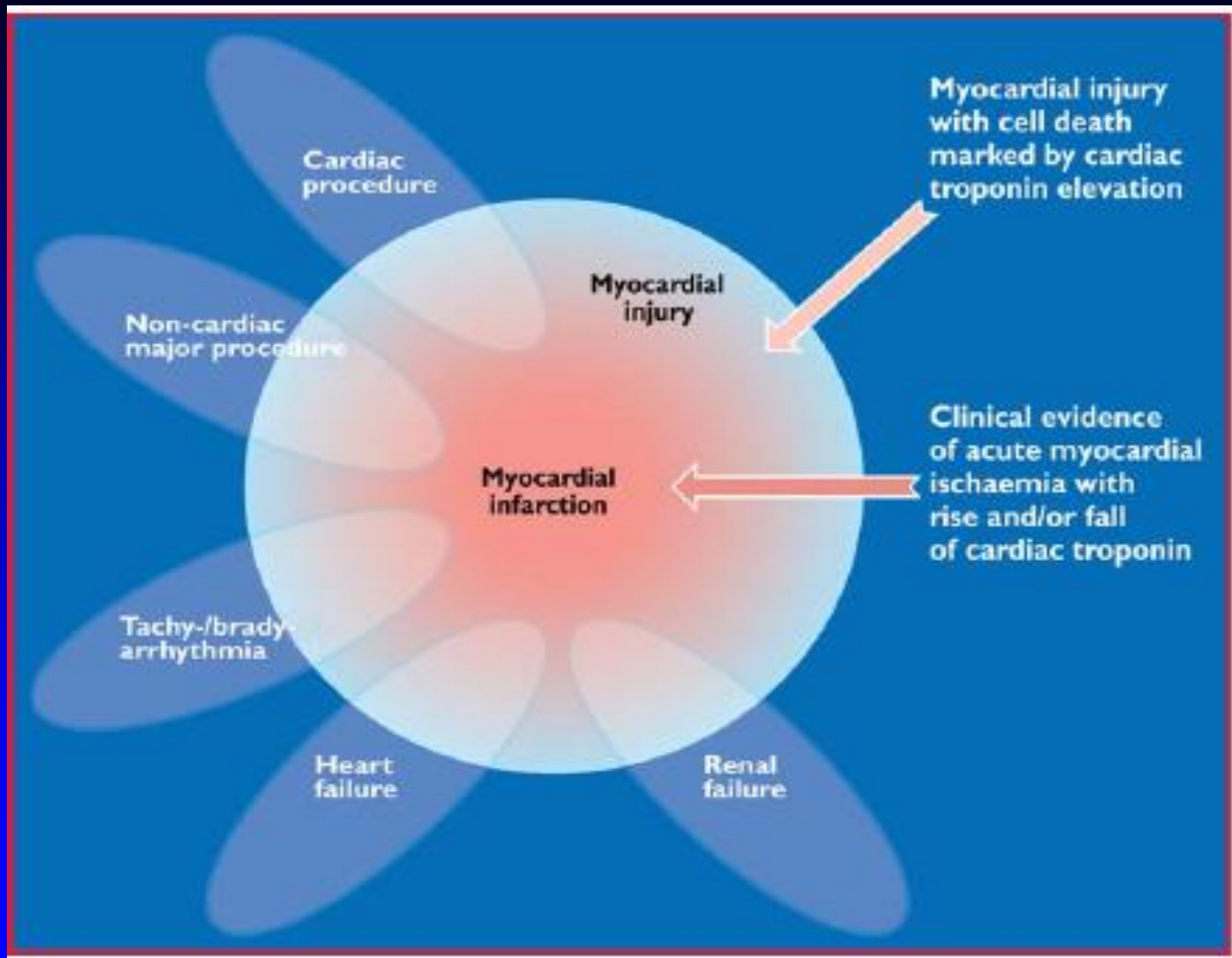
- Thin caped atheroma forms at areas of low shear stress
- Stablising plaques
 - Increase fibrosis
 - Reduce lipid core
- How do statins work?
 - Shrink lesions – no
 - Anti-inflammatory – yes
 - Reduce lipid at core of plaques – yes
 - Increase plaque fibrosis – yes
 - Increase calcification of plaques - yes

Perioperative issues

What causes the perioperative cardiac event?

- 50% plaque rupture
- 50% myocardial oxygen demand/supply problem



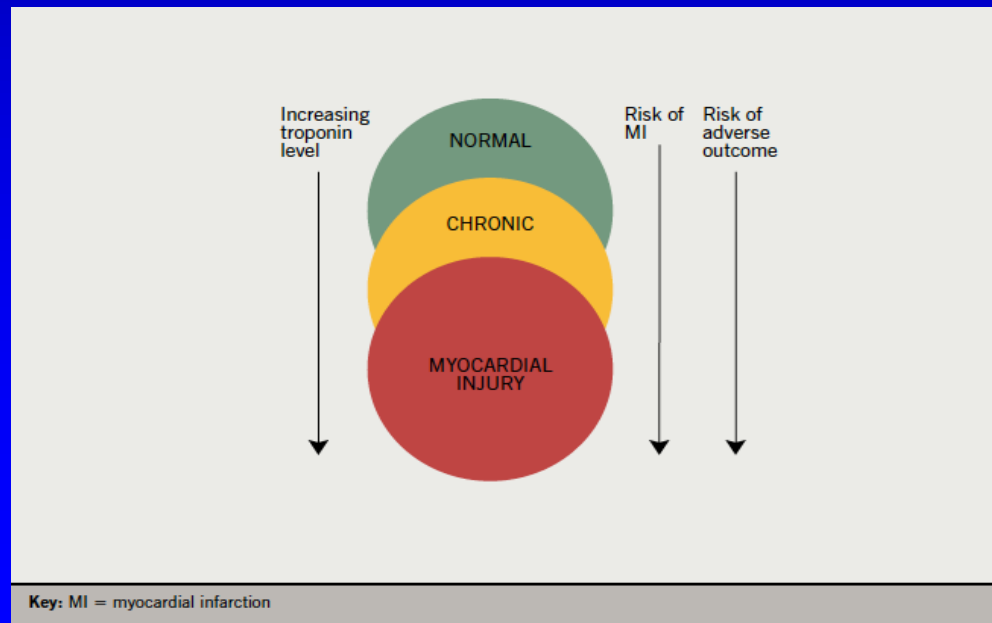


What's at my disposal?

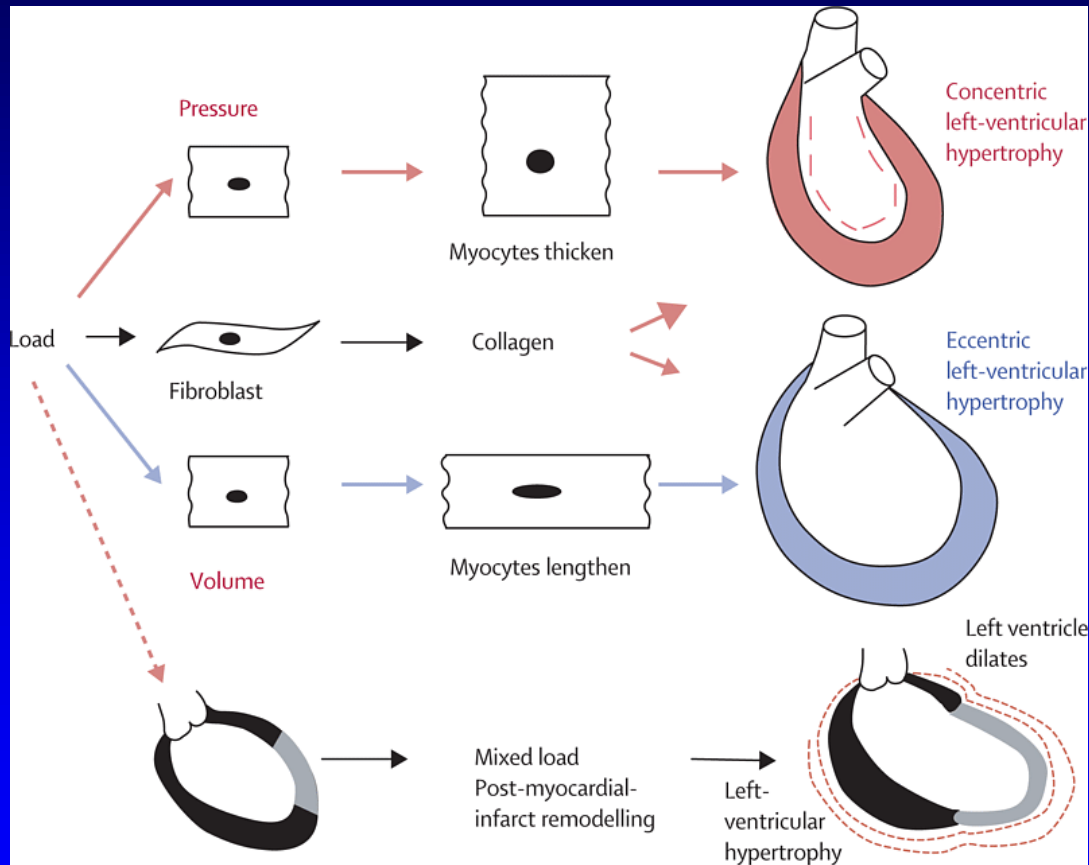
- Tn
- ECG
- Echo
- Cardiologist

Troponin: It is prognostic

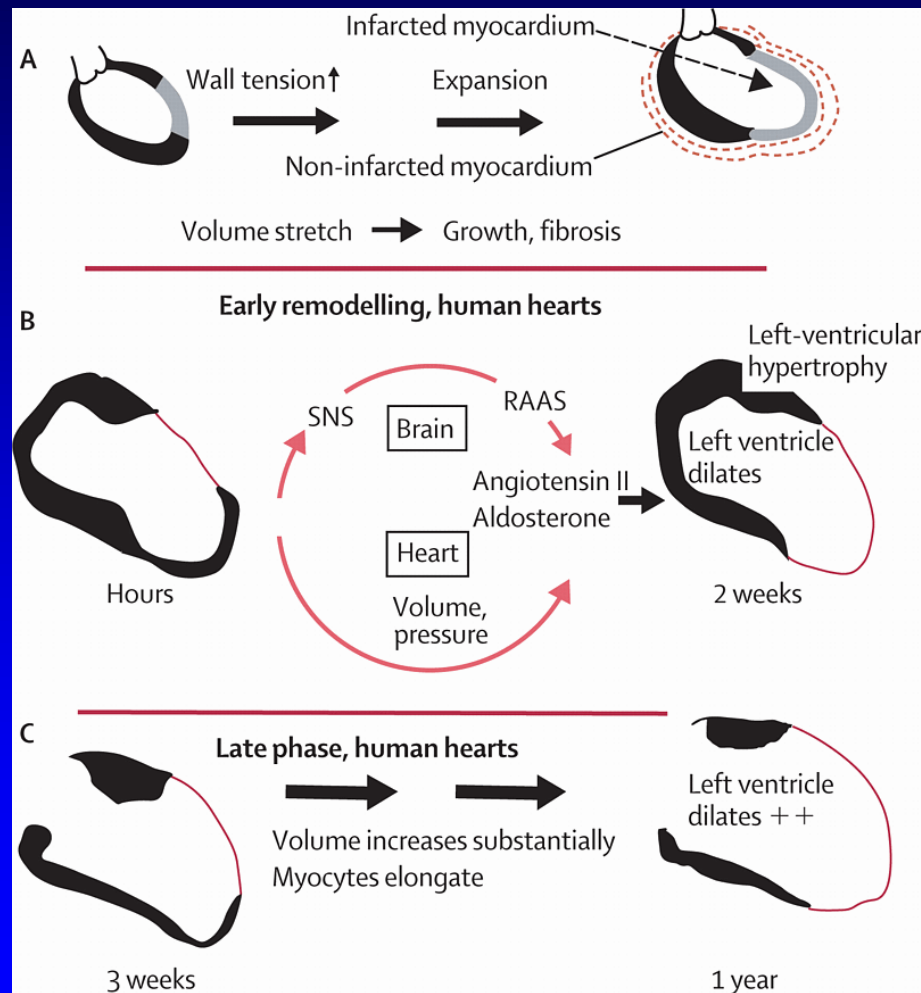
- In every condition in which it has been assessed, elevated troponin levels correlate with an adverse prognosis e.g. include heart failure, atrial fibrillation, renal failure, pulmonary embolism, sepsis and surgery.
- These findings also apply to chronic stable disease e.g. in stable outpatients with risk factors for coronary disease, the level of hsTnT detected in stored blood samples correlated closely with prognosis, with the highest risk group, who had hsTnT of over 14 ng/L, having a four-times higher risk of death over a mean follow-up period of 9.4 years.



Echo: 3 patterns of LV remodelling



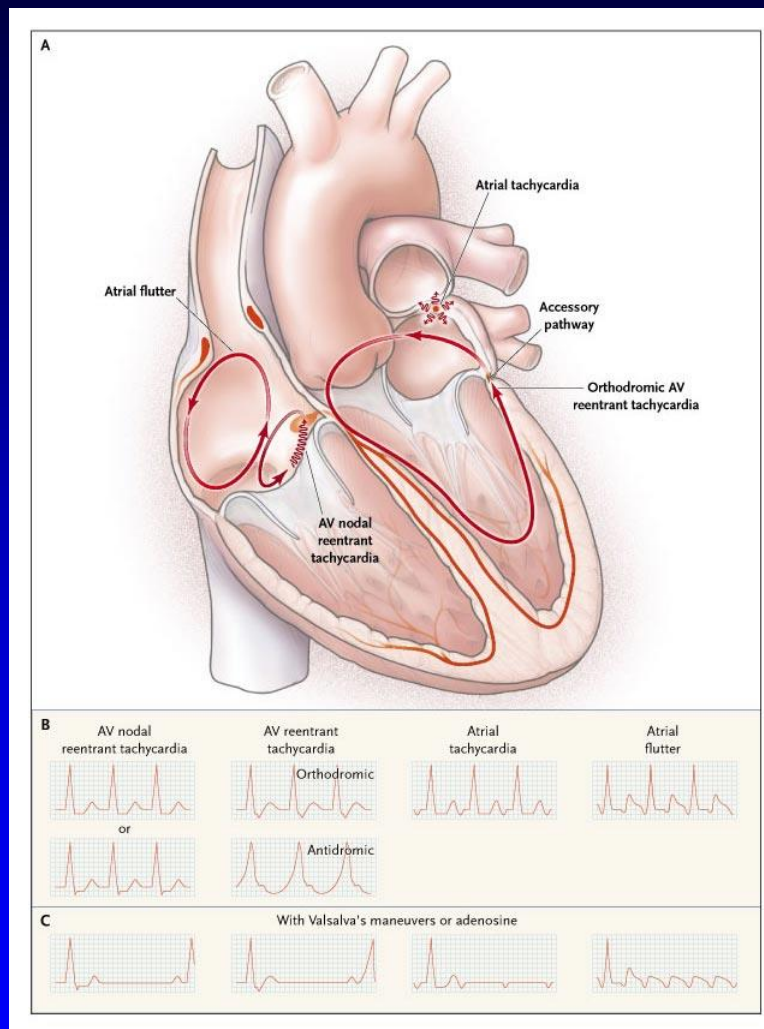
LV remodelling post-MI



Arrhythmia

- Substrate
 - Ischaemia
 - Hypertrophy
- Modulator
 - Autonomic
 - Drugs
 - Electrolytes
- Trigger
 - e.g Ectopics, after-depolarisations (EAD, DAD),

Main Mechanisms and Typical Electrocardiographic Recordings of Supraventricular Tachycardia



Delacretaz, E. N Engl J Med 2006;354:1039-1051



The NEW ENGLAND
JOURNAL of MEDICINE

Adenosine

- 6mg terminates 60% of SVT, 12mg terminates 90%
- Contraindicated in transplant recipients

Haemodynamic consequences of new onset/uncontrolled AF

- Reduced cardiac output
 - Tachycardia – risk of cardiomyopathy
 - Loss of atrial contraction
 - Irregular ventricular response
 - Impaired diastolic function leading to HF e.g. HT, LVH

Anticoagulant: Warfarin duration?

- New onset AF: clexane within 24hrs and consider cardioversion (chemical or DCCV)
- Stable: At least 3/52 before and 4/52 after DCCV (electrical restoration of SR is not immediately followed by atrial regular contraction) – consider amiodarone loading

DCCV

- Shock vector is important – AP best (lower impedance to
- Biphasic or monophasic?
 - Lower energy reqd to achieve SR with biphasic
 - Similar efficacy in achieving SR
 - Less dermal injury with biphasic
 - Less atrial stunning with biphasic? – not validated
- Internal cardioversion more successful and useful if external DCCV failed

VT

DEFINITION

- 3 or more ventricular ectopic beats in rapid succession
- sustained if >30s duration or necessitates cardioversion or pacing due to severe hypotension
- accelerated idioventricular rhythm - <120bpm. Usually seen post-MI.

Treatment

- Reverse causal factors e.g. drugs, electrolyte imbalances, ischaemia
- Cardioversion – esp if haemodynamically compromised
- Drugs – lignocaine, then mexilitine, disopyramide*, sotalol*, flecainide*, amiodarone
- Pacing:
 - Acutely- overdrive at a rate 10-30% in excess of the tachycardia, but may precipitate VF
 - Long-term – for cases where VT arises during bradycardia - pace
- Catheter based ablation of focus
- Electrical stimulation – ICD
- Specific issues – Mg in torsades

NB Some treatments are negatively inotropic e.g. Mg, lignocaine

Pacemakers

- Brady devices
 - VR/DR/CRT
 - Bipolar diathermy
- Tachy devices
 - Call for advice

Summary Ix

- TTE

- ECG

Recommendations	Class ^a	Level ^b	Ref. ^c
Pre-operative ECG is recommended for patients who have risk factor(s) ^d and are scheduled for intermediate- or high-risk surgery.	I	C	57
Pre-operative ECG may be considered for patients who have risk factor(s) and are scheduled for low-risk surgery.	IIb	C	
Pre-operative ECG may be considered for patients who have no risk factors, are above 65 years of age, and are scheduled for intermediate-risk surgery.	IIb	C	
Routine pre-operative ECG is not recommended for patients who have no risk factors and are scheduled for low-risk surgery.	III	B	71

Recommendations	Class ^a	Level ^b
Rest echocardiography may be considered in patients undergoing high-risk surgery.	IIb	C
Routine echocardiography is not recommended in patients undergoing intermediate- or low-risk surgery.	III	C

- Stress testing

Recommendations	Class ^a	Level ^b
Imaging stress testing is recommended before high-risk surgery in patients with more than two clinical risk factors and poor functional capacity (<4 METs). ^c	I	C
Imaging stress testing may be considered before high- or intermediate-risk surgery in patients with one or two clinical risk factors and poor functional capacity (<4 METs). ^c	IIb	C
Imaging stress testing is not recommended before low-risk surgery, regardless of the patient's clinical risk.	III	C

Summary

- Preoperatively: who needs to be seen?
 - Cardiac patients
 - » Optimise
 - » Beware of recent revascularisation - hang fire
 - Non-cardiac patients post/for risk stratification
 - » Most OK to proceed without cardiac revascularisation in particular
 - » High risk – consider formal risk stratification and risk reduction – BB, statins as indicated
- Perioperative issues:
 - » Tn, ECG, Echo, Cardiologist

