Managing patients admitted with....

Heart Failure

Vass Vassiliou
Royal Brompton and West Suffolk Hospitals
Imperial College London
RCP, 10th October 2016
Objectives

• Understand the principles of Heart Failure
  • Epidemiology
  • Aetiology
  • Pathophysiology

• Review the ESC 2016 guidelines for management of Heart Failure

• Discuss clinical scenarios
Eugene Braunwald

“A clinical syndrome caused by the inability of the heart to supply blood to the tissues sufficient to meet their metabolic needs, or achieved at the expense of elevated filling pressures.”
HEART FAILURE

- Inability of the heart to keep up with demand

- Inadequate perfusion of organs such as:
  - brain, liver and kidneys

- Congestion in lungs and legs

- Collection of signs and symptoms
• Typical symptoms
  • Breathlessness, ankle swelling and fatigue
• Accompanying signs
  • Elevated JVP, pulmonary crackles and peripheral oedema
• Caused by...
  • Structural or functional cardiac abnormality
    ↓ cardiac output
    ↑ intracardiac pressures
CARDIOMEGALY

UPPER LOBE DIVERSION

? PLEURAL EFFUSIONS
Symptoms

Class I-IV

How severe are the patient’s symptoms?

- **Class I** No limitation of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, or dyspnoea.
- **Class II** Slight limitation of physical activity. Comfortable at rest, but ordinary physical activity results in fatigue, palpitation, or dyspnoea.
- **Class III** Marked limitation of physical activity. Comfortable at rest, but less than ordinary activity results in fatigue, palpitation, or dyspnoea.
- **Class IV** Unable to carry on any physical activity without discomfort. Symptoms at rest. If any physical activity is undertaken, discomfort is increased.
Epidemiology

• Heart failure is common
  • 1-2% of all the adult population
  • 10% in those over the age of 70
  • 1 million patients in the UK
  • Most common cause of hospital admission in those aged >65 in high income countries
Let’s test the keypads!

There are almost one million patients with heart failure in UK. Which city has a population of approximately one million?

A. Birmingham
B. Edinburgh
C. London
D. Swansea
Let’s test the keypads!

There are almost one million patients with heart failure in UK.

Which city has a population of approximately one million?

A. Birmingham
B. Edinburgh
C. London
D. Swansea
The Starling equilibrium

Volume In

Volume Out

Stroke Volume

Preload

Volume In

Volume Out
CONGESTION

WET and WARM

DRY and WARM

NO CONGESTION

WET and WARM

DRY and WARM

WELL-PERFUSED

HYPOPERFUSED

WET and COLD

DRY and COLD
CONGESTION

NO CONGESTION

WELL-PERFUSED

HYPOPERFUSED

DRY and WARM

Stroke Volume

Preload
WET and WARM

CONGESTION

NO CONGESTION

WELL-PERFUSED

HYPOPERFUSED

Stroke Volume

Preload
What causes heart failure?

- Coronary artery disease: 34%
- Hypertension: 15%
- Valve disease: 12%
- Myocarditis: 10%
- Cardiomyopathy: 15%
- Neoplasia: 10%
- Other: 4%
• Associated with high mortality- 30% will die within one year
• 2-3% of healthcare spending
ESC 2016 Heart failure Guidelines

Ponikowski et al Eur Heart J 2016
2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure

The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC)

Developed with the special contribution of the Heart Failure Association (HFA) of the ESC

Authors/Task Force Members: Piotr Ponikowski* (Chairperson) (Poland), Adriaan A. Voors* (Co-Chairperson) (The Netherlands), Stefan D. Anker (Germany), Héctor Bueno (Spain), John G. F. Cleland (UK), Andrew J. S. Coats (UK), Volkmar Falk (Germany), José Ramón González-Juanatey (Spain), Veli-Pekka Harjola (Finland), Ewa A. Jankowska (Poland), Mariell Jessup (USA), Cecilia Linde (Sweden), Petros Nihoyannopoulos (UK), John T. Parissis (Greece), Burkert Pieske (Germany), Jillian P. Riley (UK), Giuseppe M. C. Rosano (UK/Italy), Luis M. Ruilope (Spain), Frank Ruschitzka (Switzerland), Frans H. Rutten (The Netherlands), Peter van der Meer (The Netherlands)
<table>
<thead>
<tr>
<th>Type of HF</th>
<th>HFrEF</th>
<th>HFmrEF</th>
<th>HFpEF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CRITERIA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Symptoms ± Signs&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Symptoms ± Signs&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Symptoms ± Signs&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>2</td>
<td>LVEF &lt;40%</td>
<td>LVEF 40–49%</td>
<td>LVEF ≥50%</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>1. Elevated levels of natriuretic peptides&lt;sup&gt;b&lt;/sup&gt;; 2. At least one additional criterion: a. relevant structural heart disease (LVH and/or LAE), b. diastolic dysfunction (for details see Section 4.3.2).</td>
<td>1. Elevated levels of natriuretic peptides&lt;sup&gt;b&lt;/sup&gt;; 2. At least one additional criterion: a. relevant structural heart disease (LVH and/or LAE), b. diastolic dysfunction (for details see Section 4.3.2).</td>
</tr>
</tbody>
</table>
**BNP**

- Brain natriuretic peptide
- Secreted by ventricles in response to excessive stretch
- Acts to decrease systemic vascular resistance
- Increases natriuresis
- Excellent Negative Predictive Value

<table>
<thead>
<tr>
<th>Cardiac</th>
<th>Non-cardiac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart failure</td>
<td>Advanced age</td>
</tr>
<tr>
<td>Acute coronary syndromes</td>
<td>Ischaemic stroke</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>Subarachnoid haemorrhage</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>Renal dysfunction</td>
</tr>
<tr>
<td>Left ventricular hypertrophy</td>
<td>Liver dysfunction (mainly liver cirrhosis with ascites)</td>
</tr>
<tr>
<td>Hypertrophic or restrictive cardiomyopathy</td>
<td>Paraneoplastic syndrome</td>
</tr>
<tr>
<td>Valvular heart disease</td>
<td>Chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>Congenital heart disease</td>
<td>Severe infections (including pneumonia and sepsis)</td>
</tr>
<tr>
<td>Atrial and ventricular tachyarrhythmias</td>
<td>Severe burns</td>
</tr>
<tr>
<td>Heart contusion</td>
<td>Anaemia</td>
</tr>
<tr>
<td>Cardioversion, ICD shock</td>
<td>Severe metabolic and hormone abnormalities</td>
</tr>
<tr>
<td>Surgical procedures involving the heart</td>
<td>(e.g. thyrotoxosis, diabetic ketosis)</td>
</tr>
<tr>
<td>Pulmonary hypertension</td>
<td></td>
</tr>
</tbody>
</table>
Investigations – is there HF?

- Clinical examination, ECG, chest X-ray, echocardiography
- Natriuretic peptides
  - BNP <100pg/mL, NT-proBNP <400pg/mL: Chronic heart failure unlikely
  - BNP 100–400pg/mL, NT-proBNP 400–2000pg/mL: Uncertain diagnosis
  - BNP >400pg/mL, NT-proBNP >2000pg/mL: Chronic heart failure likely
<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical</strong></td>
<td><strong>More specific</strong></td>
</tr>
<tr>
<td>Breathlessness</td>
<td>Elevated jugular venous pressure</td>
</tr>
<tr>
<td>Orthopnoea</td>
<td>Hepatojugular reflux</td>
</tr>
<tr>
<td>Paroxysmal nocturnal dyspnoea</td>
<td>Third heart sound (gallop rhythm)</td>
</tr>
<tr>
<td>Reduced exercise tolerance</td>
<td>Laterally displaced apical impulse</td>
</tr>
<tr>
<td>Fatigue, tiredness, increased time</td>
<td></td>
</tr>
<tr>
<td>to recover after exercise</td>
<td></td>
</tr>
<tr>
<td>Ankle swelling</td>
<td></td>
</tr>
<tr>
<td><strong>Less typical</strong></td>
<td><strong>Less specific</strong></td>
</tr>
<tr>
<td>Nocturnal cough</td>
<td>Weight gain (&gt;2 kg/week)</td>
</tr>
<tr>
<td>Wheezing</td>
<td>Weight loss (in advanced HF)</td>
</tr>
<tr>
<td>Bloat feeling</td>
<td>Tissue wasting (cachexia)</td>
</tr>
<tr>
<td>Loss of appetite</td>
<td>Cardiac murmur</td>
</tr>
<tr>
<td>Confusion (especially in the elderly)</td>
<td>Peripheral oedema (ankle, sacral, scrotal)</td>
</tr>
<tr>
<td>Depression</td>
<td>Pulmonary crepitations</td>
</tr>
<tr>
<td>Palpitations</td>
<td>Reduced air entry and dullness to</td>
</tr>
<tr>
<td>Dizziness</td>
<td>percussion at lung bases (pleural</td>
</tr>
<tr>
<td>Syncope</td>
<td>effusion)</td>
</tr>
<tr>
<td>Bendopnea</td>
<td>Tachycardia</td>
</tr>
<tr>
<td></td>
<td>Irregular pulse</td>
</tr>
<tr>
<td></td>
<td>Tachypnoea</td>
</tr>
<tr>
<td></td>
<td>Cheyne Stokes respiration</td>
</tr>
<tr>
<td></td>
<td>Hepatomegaly</td>
</tr>
<tr>
<td></td>
<td>Ascites</td>
</tr>
<tr>
<td></td>
<td>Cold extremities</td>
</tr>
<tr>
<td></td>
<td>Oliguria</td>
</tr>
<tr>
<td></td>
<td>Narrow pulse pressure</td>
</tr>
</tbody>
</table>
PATIENT WITH ACUTE HEART FAILURE
Bedside assessment to identify haemodynamic profiles

PRESENCE OF CONGESTION?
- YES (95% of all AHF patients)
  - ‘Wet’ patient
  - ADEQUATE PERIPHERAL PERFUSION?
    - YES
      - ‘Wet and Warm’ patient (typically elevated or normal systolic blood pressure)
      - Vascular type – fluid redistribution
      - Hypertension predominates
      - • Vasodilator
      - • Diuretic
    - NO
      - Cardiac type – fluid accumulation
      - Congestion predominates
      - • Diuretic
      - • Vasodilator
      - • Ultrafiltration (consider if diuretic resistance)
  - NO
    - ‘Dry and warm’ patient
    - ‘Dry and warm’ Adequately perfused
    - • Compensated
    - ‘Dry and cold’ patient
    - ‘Dry and cold’ Hypoperfused, Hypovolaemic
    - • Consider inotropic agent in refractory cases

- NO (5% of all AHF patients)
  - ‘Dry’ patient
  - ‘Dry’ patient

WET and WARM
Vasodilators and Diuretics
Cases
An 84 year old woman presents to the acute medical unit with a 6 week history of SOB and peripheral oedema.

**PMHx**

- MI
- PMR
- Hypertension

**Medication**

- Aspirin 75mg od
- Simvastatin 20mg od
- Prednisolone 4 mg od
- Diltiazem 60mg tds
O/E

- BP = 187/94mmHg
- Pulse = 98 bpm SR
- Elevated JVP +5 cm
- Normal HS
- Bilateral crackles
- Moderate peripheral oedema

- ECG
  - LBBB
- CXR
  - Pulmonary oedema
- FBC and U+E normal
- Troponin normal
Acute Heart Failure

• Which is the single most appropriate next step in her management?

A. Intravenous furosemide  
B. Intravenous GTN  
C. Intravenous heparin  
D. Intravenous metoprolol
Acute Heart Failure

• What is the next most appropriate step?

A. Intravenous furosemide
B. Intravenous GTN
C. Intravenous heparin
D. Intravenous metoprolol
Which medication should be discontinued?

A. Aspirin 75mg od
B. Diltiazem 60mg tds
C. Prednisolone 4 mg od
D. Simvastatin 20mg od
Which medication should be discontinued?

A. Aspirin 75mg od
B. Diltiazem 60mg tds
C. Prednisolone 4 mg od
D. Simvastatin 20mg od

Diltiazem or verapamil are not recommended in patients with HFrEF, as they increase the risk of HF worsening and HF hospitalization.
An echocardiogram is requested
According to the 2016 ESC HF Guidelines what is the diagnosis?

A. Heart failure with reduced Ejection Fraction
B. Heart failure with mildly reduced Ejection Fraction
C. Heart failure with preserved Ejection Fraction
According to the 2016 ESC HF Guidelines what is the diagnosis?

A. Heart failure with reduced Ejection Fraction, EF < 40%
B. Heart failure with mildly reduced Ejection Fraction, EF 40-49%
C. Heart failure with preserved Ejection Fraction, EF ≥ 50%
According to the 2016 ESC HF Guidelines what is the diagnosis?

A. Heart failure with reduced Ejection Fraction, $EF < 40\%$
B. Heart failure with mildly reduced Ejection Fraction, $EF 40-49\%$
C. Heart failure with preserved Ejection Fraction, $EF \geq 50\%$
What other medication should be initiated early on during the admission?

A. Amlodipine 5mg od
B. Atorvastatin 40mg od
C. Bisoprolol 2.5mg od
D. Ramipril 2.5mg od
What other medication should be initiated early on during the admission?

A. Amlodipine 5mg od
B. Atorvastatin 40mg od
C. Bisoprolol 2.5mg od
D. Ramipril 2.5mg od
Medication to initiate during admission...

- ACE Inhibitor
  - As EF<35% if still symptomatic
  - spironolactone or eplerenone
- Beta blocker
  - bisoprolol or carvedilol;
  - NOT atenolol or metoprolol
- If still symptomatic...
  - Ivabradine if HR >70 bpm in SR
  - ARNI
    - Sacubitril/valsartan if ACE I tolerated well
  - Consider CRT if QRS >130ms and LBBB or QRS >150 and RBBB
Very importantly…

• Accurate daily weight
• In/ out fluid balance chart
• Fluid restrict
• Salt restrict
• Low molecular weight heparin
• Frequent blood monitoring- daily if on iv diuretics
• Look for signs of depression
• Correct iron deficiency
What is the role of Digoxin?

Digoxin may be considered in symptomatic patients in sinus rhythm despite treatment with an ACE-I (or ARB), a beta-blocker and an MRA, to reduce the risk of hospitalization (both all-cause and HF-hospitalizations).
Is there a role for hydralazine and ISDN?

<table>
<thead>
<tr>
<th>Hydralazine and isosorbide dinitrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydralazine and isosorbide dinitrate should be considered in self-identified black patients with LVEF ≤35% or with an LVEF &lt;45% combined with a dilated LV in NYHA Class III–IV despite treatment with an ACE-I a beta-blocker and an MRA to reduce the risk of HF hospitalization and death.</td>
</tr>
<tr>
<td>Hydralazine and isosorbide dinitrate may be considered in symptomatic patients with HFrEF who can tolerate neither an ACE-I nor an ARB (or they are contra-indicated) to reduce the risk of death.</td>
</tr>
</tbody>
</table>
What else should be arranged prior to discharge?

A. Enrolment in a disease management programme
B. Hospital appointment within 2 weeks of discharge
C. Review by their general practitioner within 1 week of discharge
D. All of the above
What else should be arranged prior to discharge?

A. Enrolment in a disease management program
B. Hospital appointment within 2 weeks of discharge
C. Review by their general practitioner within 1 week of discharge
D. All of the above
Case 2

A 36 year old man presents to the acute medical unit with breathlessness and chest pain on and off for two days.

**O/E**

- Elevated JVP
- Bilateral crackles
- Mild peripheral oedema

**Investigations**

- Admission troponin 400 ng/L (normal <40)
- 12 hour troponin 1200 ng/L
ECG on admission
What is the provisional diagnosis?

A. Myocarditis
B. NSTEMI
C. Pulmonary embolus
D. STEMI
What is the provisional diagnosis?

A. Myocarditis
B. NSTEMI
C. Pulmonary embolus
D. STEMI
Investigations
He still has ongoing chest pain...

What is the single most appropriate investigation to confirm the diagnosis?

A. Cardiovascular Magnetic Resonance
B. Coronary angiography
C. Exercise test
D. Transthoracic echocardiography
He still has ongoing chest pain...

What is the single most appropriate investigation to confirm the diagnosis?

A. Cardiovascular Magnetic Resonance
B. Coronary angiography
C. Exercise test
D. Transthoracic echocardiography
Management

• Aspirin and Clopidogrel - he is troponin positive...
Management

• Aspirin and Clopidogrel — Troponin positive...
Causes of acute heart failure

<table>
<thead>
<tr>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute coronary syndrome.</td>
</tr>
<tr>
<td>Tachyarrhythmia (e.g. atrial fibrillation, ventricular tachycardia).</td>
</tr>
<tr>
<td>Excessive rise in blood pressure.</td>
</tr>
<tr>
<td>Infection (e.g. pneumonia, infective endocarditis, sepsis).</td>
</tr>
<tr>
<td>Non-adherence with salt/fluid intake or medications.</td>
</tr>
<tr>
<td>Bradyarrhythmia.</td>
</tr>
<tr>
<td>Toxic substances (alcohol, recreational drugs).</td>
</tr>
<tr>
<td>Drugs (e.g. NSAIDs, corticosteroids, negative inotropic substances,</td>
</tr>
<tr>
<td>cardiotoxic chemotherapeutics).</td>
</tr>
<tr>
<td>Exacerbation of chronic obstructive pulmonary disease.</td>
</tr>
<tr>
<td>Pulmonary embolism.</td>
</tr>
<tr>
<td>Surgery and perioperative complications.</td>
</tr>
<tr>
<td>Increased sympathetic drive, stress-related cardiomyopathy.</td>
</tr>
<tr>
<td>Metabolic/hormonal derangements (e.g. thyroid dysfunction, diabetic</td>
</tr>
<tr>
<td>ketosis, adrenal dysfunction, pregnancy and peripartum related</td>
</tr>
<tr>
<td>abnormalities).</td>
</tr>
<tr>
<td>Cerebrovascular insult.</td>
</tr>
<tr>
<td>Acute mechanical cause: myocardial rupture complicating ACS (free wall</td>
</tr>
<tr>
<td>rupture, ventricular septal defect, acute mitral regurgitation), chest</td>
</tr>
<tr>
<td>trauma or cardiac intervention, acute native or prosthetic valve</td>
</tr>
<tr>
<td>incompetence secondary to endocarditis, aortic dissection or thrombosis</td>
</tr>
</tbody>
</table>
Myocarditis

What are the concerns?

- Heart failure
- Arrhythmias
  - Brady
  - Tachy
- Death
Management

• Heart failure management
  • Transfer to referral centre if signs of severe HF
  • Consideration for LVAD and transplantation

• Monitor rhythm

• Treat heart failure
  • Frusemide
  • GTN
  • ACE I
  • B blockers
  • Inotropes

• Colchicine

• High Dose NSAIDS

AVOID STEROIDS
Case 3

A 47 year old man presents with breathlessness for a week and this morning he collapsed at work. He has pleuritic chest pain.

- BP 95/66mmHg
- HR 120bpm
- HS normal
- Chest clear
- JVP +5cm
- Moderate peripheral oedema
- BNP raised (600 pg/ mL)
- Troponin raised (320 ng/ L)
A portable echo was done...
More images...
What would you do next?

A. Intravenous furosemide
B. Intravenous heparin
C. Intravenous alteplase
D. Intravenous GTN
What would you do next?

A. Intravenous furosemide
B. Intravenous heparin
C. Intravenous alteplase
D. Intravenous GTN
**A** Right-sided heart failure  
(Back-ups in the area that collects “used” blood)

**B** Left-sided heart failure  
(Failure to properly pump out blood to the body)

**C** Congestive heart failure  
(Fluid collects around the heart)
Learning points

• Three categories of heart failure

• Look for the aetiology of heart failure

• Appropriate Investigations

• Multidisciplinary work

• Acute management
  • Diuresis and nitrates
  • Inotropes

• Chronic management
  • Diuretics
  • ACE I
  • B blocker
  • Mineralocorticoid antagonists
    • Ivabradine
    • ARNI- sacubitril/valsartan
    • CRT
Conclusion

Reviewed pathophysiology of heart failure

Discussed recent ESC HF guidelines

Evaluated the management of clinical cases
Thank you!

v.vassiliou@rbht.nhs.uk
References

• Material used available from the following sources:
  • www.studyblue.com
  • www.heart.org
  • www.patient.info
  • www.findingmedicalsolutions.com
Case 4

A 22 year old woman presents to the acute medical unit with breathlessness, palpitations and episodes of dizziness.

**O/E**

- Elevated JVP
- Bilateral crackles in lower bases
- Mild peripheral oedema
- Systolic murmur

**Investigations**

- Admission troponin 33 ng/L (normal <40)
- 12 hour troponin 567 ng/L
Soon after the admission she had multiple NSVT on telemetry and an urgent echo was organised
What is the diagnosis?

• Dilated cardiomyopathy
• Hypertrophic cardiomyopathy
• Ischaemic cardiomyopathy
• Takotsubo cardiomyopathy
What is the diagnosis?

• Dilated cardiomyopathy
• Hypertrophic cardiomyopathy
• Ischaemic cardiomyopathy
• Takotsubo cardiomyopathy
HCM Risk-SCD Calculator

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td>Age at evaluation</td>
</tr>
<tr>
<td>Maximum LV wall thickness</td>
<td></td>
<td>Transthoracic Echocardiographic measurement</td>
</tr>
<tr>
<td>Left atrial size</td>
<td></td>
<td>Left atrial diameter determined by M-Mode or 2D echocardiography in the parasternal long axis plane at time of evaluation</td>
</tr>
<tr>
<td>Max LVOT gradient</td>
<td></td>
<td>The maximum LV outflow gradient determined at rest and with Valsalva provocation (irrespective of concurrent medical treatment) using pulsed and continuous wave Doppler from the apical three and five chamber views. Peak outflow tract gradients should be determined using the modified Bernoulli equation: Gradient = 4V^2, where V is the peak aortic outflow velocity</td>
</tr>
<tr>
<td>Family History of SCD</td>
<td>No/Yes</td>
<td>History of sudden cardiac death in 1 or more first degree relatives under 40 years of age or SCD in a first degree relative with confirmed HCM at any age (post or ante-mortem diagnosis).</td>
</tr>
<tr>
<td>Non-sustained VT</td>
<td>No/Yes</td>
<td>3 consecutive ventricular beats at a rate of 120 beats per minute and &lt;30s in duration on Holter monitoring (minimum duration 24 hours) at or prior to evaluation.</td>
</tr>
<tr>
<td>Unexplained syncope</td>
<td>No/Yes</td>
<td>History of unexplained syncope at or prior to evaluation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk of SCD at 5 years (%)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC recommendation:</td>
<td></td>
</tr>
</tbody>
</table>
**HCM Risk-SCD Calculator**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>22 Years</td>
<td>Age at evaluation</td>
</tr>
<tr>
<td>Maximum LV wall thickness</td>
<td>32 mm</td>
<td>Transthoracic Echocardiographic measurement</td>
</tr>
<tr>
<td>Left atrial size</td>
<td>55 mm</td>
<td>Left atrial diameter determined by M-Mode or 2D echocardiography in the parasternal long axis plane at time of evaluation</td>
</tr>
<tr>
<td>Max LVOT gradient</td>
<td>30 mmHg</td>
<td>The maximum LV outflow gradient determined at rest and with Valsalva provocation (irrespective of concurrent medical treatment) using pulsed and continuous wave Doppler from the apical three and five chamber views. Peak outflow tracts should be determined using the modified Bernoulli equation: Gradient = 4V^2, where V is the peak aortic outflow velocity.</td>
</tr>
<tr>
<td>Family History of SCD</td>
<td>No/Yes</td>
<td>History of sudden cardiac death in 1 or more first degree relatives under 40 years of age or SCD in a first degree relative with confirmed HCM at any age (post or ante-mortem diagnosis).</td>
</tr>
<tr>
<td>Non-sustained VT</td>
<td>No/Yes</td>
<td>3 consecutive ventricular beats at a rate of 120 beats per minute and &lt;30s in duration on Holter monitoring (minimum duration 24 hours) at or prior to evaluation.</td>
</tr>
<tr>
<td>Unexplained syncope</td>
<td>No/Yes</td>
<td>History of unexplained syncope at or prior to evaluation.</td>
</tr>
</tbody>
</table>

Risk of SCD at 5 years (%): **11.13**

ESC recommendation: ICD should be considered