

CARDIOMYOPATHIES

DISORDERS

- Dilated cardiomyopathy
- Hypertrophic cardiomyopathy
- Restrictive cardiomyopathy
- Arrhythmogenic right ventricular cardiomyopathy
- Unclassified

PRIMARY CARDIOMYOPATHY

Genetic

- HCM
- ARVD/C
- LV Non compaction
- Glycogen storage
- Mitochondrial myopathy
- Muscular dystrophies
- Neuromuscular disorders
- Ion channels disorder (LQTS, Brugada, SQTS, CVPT)

Mixed

- Dilated cardiomyopathy
- Restrictive (non hypertrophied and non dilated)

Acquired

- Inflammatory
- Stress-induced
- Peripartum
- Tachycardia-induced

DILATED

- Most common cardiomyopathy
- Enlargement of one or both ventricles and systolic dysfunction
- Generally precedes signs and symptoms of HF
- Broad spectrum of cardiac and systemic conditions associated with DCM = **variety of causes**
- 50% have idiopathic DCM

Natural history

- Different evolution and presentation
- Annual mortality: 10-50%
- All progress in symptomatic HF

- Medical treatment is important to recovery or reverse LV remodeling → **25-33% recovery in patients with DCM *de novo***

Prognosis

- Importance on finding the **cause** = evolution is different depending on the cause of DCM
- Patients can have a period of clinical stability, ranging from years to decade
- Reverse remodeling can be spontaneous or in response of medical or device therapy
- Patients may have sudden deterioration and then have again a state of stability
- Certain patients have severe or life threatening hemodynamic conditions at initial presentations – **endomyocardial biopsy is required**
 - o Inotropes and mechanical support can be lifesaving
- **Genetic component (inherited predisposition) implicated in DCM, playing a role in natural history of the disorder**

Pathology

- 4 chamber enlargement
- LVH – **myocyte hypertrophy**
 - o Compensatory mechanism to reduce wall stress (↓ remodeling)
- Interstitial fibrosis – **mostly located in LV subendocardium or throughout the myocardium in interstitial patterns**
- Dilation of valvular orifice
- Apical thrombus
- Ischemic CMP associated with stenosis $\geq 70\%$ in epicardial coronary arteries
 - o If non occlusive stenosis, DCM is usually out of proportion to underlying CAD
- Presence of lymphocytes in myocarditis
- Necrosis = ischemic etiology

Etiology

- Accounts for **25%** cases of congestive heart failure
- **50% idiopathic**
- **Stress (Takotsubo)**
 - o Provoked by a stress or emotional situation = high doses of *catecholamines*
 - o Middle ages women
 - o Reversible in most case with support care
 - o ECG findings of MI with LV dysfunction and absence of CAD
 - o Biopsy: contraction band necrosis
- **Peripartum CMP**
 - o **1 month before delivery to 6 months post partum**
 - o High incidence of lymphocytic inflammation
 - o Excellent long-term evolution in Africa but worse prognosis in developing Countries
 - o **Increase risk of recurrence with subsequent pregnancies**
 - o Women with LV recovery are more likely to tolerate a subsequent pregnancy than are those with residual LV dysfunction
- **Tachycardia-induced CMP**
 - o AF or SVT
 - o High rate of recovery with control of the arrhythmia
- **Alcoholic CMP**
 - o **Most common cause of secondary CMP**
 - o Resembles idiopathic DCM

- Response to cessation
- **Idiopathic DCM**
 - Familial (**25-33% cases**)
 - 30 genes
 - *MYBPC3, MYH7, TNNT2, LMNA, and SCN5A* genes
 - Autosomal dominant with incomplete penetrance
 - 15-30% family variants
 - Involves myocyte sarcomere and cytoskeleton
 - Inflammatory and infectious myocarditis
 - Cytotoxicity
 - Cell loss and endogenous repair

Clinical evaluation

- Incidence 5-8 per 100,000 persons/year
- Prevalence 1:2500
- All ages, most common in middle age
- **Men >>> women**
- Great variation in clinical presentation – symptoms of HF varying from weeks to months
- Minority of patients with aggressive illness – fulminant lymphocytic myocarditis = giant cell myocarditis

Noninvasive evaluation

- Electrolytes (PO₄, calcium)
- Renal function
- Thyroid
- Catecholamines levels in urine
- VS, CRP
- Antibodies for rheumatoid conditions (if necessary)
- Iron study
- HIV
- Uric acid, NT-proBNP, troponin
- *Chest X-RAY*: cardiomegaly, pulmonary vascular redistribution, interstitial edema, dilated azygos vein (right side overload)

ECG

- Poor R wave progression
- Intraventricular conduction delay
- LBBB
- WIDE QRS complex: poor prognosis
- NSVT (very frequent): poor prognosis of all cause mortality
- Anterior Q waves with LV fibrosis

TTE

- Ventricular size and performance
- R/O valvular or pericardial abnormalities
- Restrictive filling patterns
- Pericardial effusion
- Dobutamine – r/o ischemic disease with regional wall motion abnormalities

RADIONUCLIDE IMAGING

- Exclude ischemic disease from DCM
- EF, chamber volumes LVEDV, LVESV

MRI

- ARVD/C
- Endocardial fibroelastosis, myocarditis, amyloidosis, sarcoidosis
- **Fibrosis – predisposition to VT and sudden death**
- Infiltrative and inflammatory cardiomyopathy

CATHETERIZATION AND ENDOMYOCARDIAL BIOPSY

- Coronary angiogram = **essential to r/o CAD**
- Acquisition of myocardium with *bioptome*, under fluoroscopy or echo guidance
- Negative biopsy for inflammation with rapid progression of severe decompensated HF prompts to aggressive mechanical support early in patient treatment
- Benefit >> risk
- Fulminant presentation requires urgent management and heart transplant listing or insertion of mechanical device
- Class I recommendations
 - o New onset of HF of < 2 weeks duration associated with normal sized or dilated LV and hemodynamic compromises
 - o New onset of HF of 2 weeks – 3 months duration associated with a dilated LV and new ventricular arrhythmias, second or third AV block, or failure to respond to usual care within 1-2 weeks

Management

- Current treatment of HF
- ICD and CRT
 - o EF < 35% and worsening NYHA class = ICD should be considered
 - o QRS > 150 ms and NYHA class impaired = CRT to consider
- **EPS study is not recommended**

GENETIC TESTING

- **Not recommended** without established or probable family disease – family history and clinical testing of 1st degree relatives
- Questions to ask the proband (**increase probability of disease**):
 - o Family member with device
 - o Unexplained sudden cardiac death below 50 years old
 - o Skeletal muscle disorder (LMNA)
 - o Heart failure

★ **Suggested reference:** Gollob MH et al. Recommendations for the use of genetic testing in the clinical evaluation of inherited cardiac arrhythmias associated with sudden cardiac death: Canadian cardiovascular society/Canadian heart rhythm society joint position paper. Can J Cardiol 2011;27 :232-245.

RESTRICTIVE AND INFILTRATIVE CARDIOMYOPATHY

- Important cause of morbidity and mortality
- High incidence in **underdeveloped countries**
- ↑ Stiffness of ventricular wall = HF with **impaired diastolic filling of ventricles**
 - o Myocardial fibrosis, infiltration or scarring of endomyocardial surface, myocyte hypertrophy
- Systolic function usually normal but deteriorates as disease progresses
- 50% cases of specific disorder: 50% idiopathic
 - o Most common specific disorder is **amyloidosis**

CLASSIFICATION

Myocardial

1. Noninfiltrative: idiopathic, familial cardiomyopathy, HCM, scleroderma, pseudoxanthoma elasticum, diabetic cardiomyopathy
2. Infiltrative: amyloidosis, sarcoidosis, Gaucher disease, Hurler disease, Fatty infiltration
3. Storage disease: hemochromatosis, Fabry disease, Glycogen storage disease

Endomyocardial

Endomyocardial fibrosis, hypereosinophilic syndrome, carcinoid heart disease, metastatic cancers, radiation, toxic effects of anthracycline, drugs causing fibrous endocarditis (serotonin, ergotamine, busulfan, mercurial agents, methysergide)

CARDIAC CATHETERIZATION AND ENDOMYOCARDIAL BIOPSY

- **Constrictive physiology**
 - o Rapid filling wave – early diastolic filling = **pericardial knock**
 - o Dip and plateau / square root sign
 - o M or W sign: big x and y descent
 - o ↑ Mean RAP at inspiration = **Kussmaul**
 - o Equalizing of diastolic pressures in 4 chambers (LVEDP – RVEDP < 5 mm Hg)
 - o Absence of significant pulmonary HTN < 55 mm Hg
 - o RVEDP/RVSP > 1/3
 - o **Intrathoracic-intracardiac dissociation**: variation of wedge to LV diastolic pressure ≥ 5 mmHg from inspiration to expiration (LV acutely underfilled during inspiration = pressure drop) - ↑ interdependence phenomenon with ↑ RV diastolic filling during inspiration. **Findings are very sensitive, but poorly specific for constriction because they are often seen in restrictive pattern**
 - o **Volume loading** – equalizing of diastolic pressures after volume loading
- **Restrictive physiology**
 - o Severe diastolic dysfunction with preserve EF
 - o Diastolic filling is restricted by the myocardium
 - o Rapid x and y descents
 - o Kussmaul +

- Dip and plateau
- **Interdependence phenomenon is NOT accentuated – restriction of IV septum which impedes septum shift towards LV during inspiration**
- Pulmonary hypertension PAP systolic > 50 mm Hg
- RVEDP/RVSP < 1/3
- Equalizing of diastolic pressures in 4 chambers (LVEDP – RVEDP > 5 mm Hg)

ECHOCARDIOGRAPHY

➤ Restrictive physiology

- Anomaly of the myocardium (fibrosis)
- Preserved systolic function
- Elevated diastolic pressures
- Dilatation of both atrium, normal LV size, normal myocardial walls
- Elevated LA pressure, decreased compliance
- Restrictive pattern – grade 3-4
- Rapid E, short DT and IVRT, E/A > 2, venous flow increase in diastole and decrease in systole
- **Reverse diastolic hepatic venous flow during inspiration**

➤ Constrictive physiology

- Pericardial thickening
 - No transmission of intrathoracic pressure changes towards the pericardium and cardiac chambers
- Abnormal IV septum movement = exaggerated interdependence phenomenon between ventricles
- Flattening of posterior wall of LV during *diastole*
- Dilated IVC
- Variations of ventricular cavity sizes during respiration
 - **Inspiration**: pulmonary vein pressures decrease with intrathoracic pressure but not transmitted to cardiac cavities, leading to a decrease in pressure gradient of LV filling just after inspiration and increase at expiration– **↑ RV filling and ↓ LV filling**
 - **Expiration**: IV septum shifts to the right, limiting RV filling = decrease the flow through tricuspid valve
 - **Reverse diastolic hepatic venous flow during expiration**
 - **E mitral flow variations ≥ 25% during expiration**
 - Velocities at septal mitral valve are normal – ventricular filling is limited to a lateral expansion of the heart (exaggerated longitudinal movement = *anulus paradoxus*) and relaxation is preserved.

★ Suggested reference: Nagueh SF, et al. Recommendations for the evaluation of left ventricular diastolic function by echocardiography. 2009 J Am Society Echocardiography;22:108-133.

	Restriction	Constriction
Septal motion	Normal	Respiratory shift
Mitral E/A ratio	> 1.5	> 1.5
Mitral DT (ms)	< 160	< 160
Mitral inflow respiratory variation	Absent	Usually present
Hepatic vein Doppler	Inspiratory diastolic flow reversal	Expiratory diastolic flow reversal
Mitral septal annular e'	Usually < 7 cm/s	Usually > 7 cm/s
Mitral lateral annular e'	Higher than septal e'	Lower than septal e'
Ventricular septal strain	Reduced	Usually normal

Hemodynamic variations:

- Increase atrial pressures
- Equalization of pressures during diastole
- *Dip-and-plateau* of ventricular diastolic pressure

Prognosis

- Depends on the etiology – mortality accelerated in patients with amyloidosis

Clinical manifestations

- Exercise intolerance Weakness, edema, dyspnea, chest pain
- Symptoms of RV failure in advanced disease = difficult volume management
- *Kussmaul* with PVC elevated
- S3 and S4 presents

Laboratory findings

- Thick pericardium = constrictive pericarditis
- Pericardial calcifications on chest X-RAY
- TTE
 - Constrictive vs. restrictive pattern
 - Biatrial dilation
 - Increase wall thickness
 - Impaired myocardial relaxation on Doppler with increase LV filling velocities, decrease atrial filling velocity
- BNP

A. AMYLOIDOSIS

- Tissue deposition of protein = **amyloid**
- *Primary amyloidosis*: deposition of immunoglobulin light chains = **AL amyloid**
- *Secondary amyloidosis*: reactive systemic amyloidosis from excess production of nonimmunoglobulin protein AA = **AA amyloid**
- *Familial amyloidosis*: Mutations in **transthyretin gene** responsible of 3 clinical scenarios = nephropathy, neuropathy and DCM

CARDIAC AMYLOIDOSIS

- Men >> women
- Rare before age 40

- Very bad prognosis
- 1/3 cardiac involvement with AL form, less in AA form, 1/4 familial form have clinical cardiac involvement – conduction system
- [Typical green color from staining with Congo red](#)
- **Atria are enlarged, thickening of cardiac valves without valvular dysfunction**
- Rubbery consistency of the myocardium in advanced disease
- **Restrictive CMP**
 - ↑ Diastolic stiffness and LV filling
 - RV failure
- **Systolic HF**
 - Deteriorates throughout progression of disease, with angina
- **Orthostatic hypotension**
 - 10% patients
 - Infiltration of autonomic nervous system and/or blood vessels
 - Renal failure – nephrotic syndrome
- **Conduction system disease**
 - Malignant arrhythmias and AV block
 - Syncope

Clinical examination

- PVC elevated
- Signs of RV failure
- S3
- AF – atrial infiltration
- Skin involvement (raccoon eyes, macroglossia), shoulder pads

Noninvasive testing

- Low QRS voltages
- BBB
- ↑ PR
- Absent R wave or inferior Q waves
- AV conduction defects

Echocardiogram - TTE

- ↑ Ventricular wall thickness
- Small cavity chambers, non dilated
- Enlarged atria
- Sparkling or granular texture
- Thickening of cardiac valves – no valvular dysfunction
- Pericardial effusion
- Diastolic and systolic dysfunction
 - Restrictive pattern $E > A$
 - $E/e' > 15 = \uparrow$ filling pressures

Diagnosis

- Endomyocardial biopsy
- Biopsy: rectum, fat pad, gingiva, BMO, liver, kidney
- Electrophoresis of plasma and urine + immunofixation

- Light chains κ and λ

Management

- AL: chemotherapy (Melphalan) with bone marrow transplant
- Heart transplant with BMO transplant have some success, but amyloid will recur in transplant heart
- Avoid digitalis, CCB, careful with diuretics
- ICD ?
- ACO if AF

B. FABRY

- X linked recessive disorder
- Deficiency in alpha-galactosidase in lysosomes
- Accumulation of glycolipid in endothelium – myocardium, valves, conduction system,
- Males have symptomatic CV events
- HTN, HF, mitral valve prolapse
- **TTE: increase ventricular wall thickness**
- **CMR is able to differentiate Fabry from other infiltrative disease**
- **ECG: short PR, AV block, ST-T abnormalities**
- **Treatment: enzyme replacement**

C. HEMOCHROMATOSIS

- Excessive iron deposition in heart, liver, gonad and pancreas
- Classic pentad: **HF, cirrhosis, impotence, diabetes and arthritis**
- Mutation of HFE gene
- 2nd to ineffective EPO, chronic liver disease of excessive intake of iron (IV or oral) – transfusions
- Systolic and diastolic dysfunction
- Older women (menstruation = lost of iron)
- **Echo: dilated and thick ventricles, LV dysfunction**
- **ECG: arrhythmias, ST-T abnormalities**
- \uparrow Plasma iron, ferritin, urinary iron, liver iron, saturation of transferrin
- Treatment: repeat phlebotomies and chelating agents (deferoxamine), heart transplant (5-10 year survival)

D. SARCOIDOSIS

- Noncaseating granuloma in lungs, reticuloendothelial system and skin
- Involves directly the heart : infiltration of conduction system and myocardium = **HF, block, malignant arrhythmias, sudden death**
- 2nd to extensive pulmonary fibrosis – leading to advanced R-sided HF
- Granuloma in **IV septum and LV free wall**, involving conduction system = **patchy distribution (false negative endomyocardial biopsy)**
- Aneurysm formation of transmural free wall
- Death from arrhythmia, HF from cardiac involvement or from cor pulmonale in pulmonary fibrosis
- **Echo: global and region LV dysfunction, RV hypertrophy and pulmonary HTN, LV aneurysm, diastolic dysfunction and impaired filling**
- **CMR (very sensitive) and nuclear imaging (perfusion defects due to granulomatous inflammation)**

- *Management*: corticosteroids, antiarrhythmic ineffective, PMP/ICD

E. ENDOMYOCARDIAL DISEASE

Löffler endocarditis: hypereosinophilic syndrome

- Eosinophil of more 1500/mm³ for 6 months
- Involves heart, brain, lungs, BMO
- Endocardial thickening of inflow regions and apices - fibrosis
- Mural thrombus containing eosinophil
- HF in 50% patients – restrictive LV and RV filling
- Systemic emboli
- Rapidly progressive, aggressive
- Men ++
- *Echo*: LV and RV thrombus packing the ventricular apices = **box glove sign**, dilated atria, restrictive pattern, MR (fibrosis), LV thrombus at apex, good LV function, RV thrombus, restriction of mitral and tricuspid valve mobility, mitral and tricuspid regurgitation (often severe), E/A > 1
- *Treatment*: corticosteroids and hydroxyurea, IFN as adjunctive therapy, surgery (endocardectomy and valve replacement) for symptoms palliation

Endomyocardial fibrosis

- Africa and tropical areas
- Children and young adults
- Male ++, black > white
- Fibrosis affecting inflow of R and L ventricles = AV valves involvement, causing mitral and tricuspid regurgitation
 - o **50% both ventricles, 40% LV, 10% RV**
- *Echo*: dilated RA, pericardial effusion, thrombus may be present
- **Fibrotic obliteration of apex of affected ventricles**
- Does NOT involve epicardium
- **Predominant R-side disease**
- Dx: endomyocardial biopsy (patchy distribution – false negatives)
- *Management*: surgical resection with AV valve replacement, rate control, diuretics

F. CARCINOID

- *Symptoms*: flushing, diarrhea, bronchoconstriction, endocardial plaques – **50% heart disease and 25% severe R-sided involvement**
- Release of serotonin from tumor – 60-90% from gut
- R-sided > L-sided
- **Tricuspid regurgitation always present**, with either stenosis or regurgitation of pulmonary valve
- RA enlargement
- *Treatment*: somatostatin analogues, chemotherapy, valve replacement

G. ARVC/D – *Arythmogenic right ventricular dysplasia*

- 20% of sudden death – higher prevalence in young athletes
- Presentation: palpitations, syncope and sudden death

- HF in minority of patients but predominant mode of death because of ICD protects from sudden death
- VT triggered by effort
- **Fibrofatty replacement of myocardium predominantly in RV** – transmural from inflow tract, outflow tract or apex = *triangle of dysplasia* – aneurysmal dilatation
- Autosomal dominant
- Prevalence 1 in 2000 to 1 in 5000
- 3 Men: 1 Women
- Symptoms appearing between 20-40 years old
- Genes that encodes for desmosomal proteins

Diagnostic criteria (See Braunwald)

- Global or regional dysfunction structural alteration
- Tissue characterization of walls
- Repolarization abnormalities
- Depolarization/conduction abnormalities
- Arrhythmias
- Family history

Definite diagnosis:

- 2 major criteria or 1 major and 2 minor or 4 minor from different categories

Borderline diagnosis:

- 1 major and 1 minor or 3 minor from different categories

Possible diagnosis:

- 1 major or 2 minor

Risk stratification

HIGH-RISK FOR SUDDEN CARDIAC DEATH

- < 35 years old
- Syncope
- ACR
- Rapid VT, no morphology, not well tolerated
- Severe RV dysfunction, LV alteration
- Family history of juvenile sudden cardiac death
- Men
- NSVT
- Genetic: mutations of TMEM43 or RyR2

Genetic screening

★ **Suggested reference:** Gollob MH et al. Recommendations for the use of genetic testing in the clinical evaluation of inherited cardiac arrhythmias associated with sudden cardiac death: Canadian cardiovascular society/Canadian heart rhythm society joint position paper. Can J Cardiol 2011;27 :232-245.

TREATMENT

ICD

- Sustained VT/VF on medical therapy

- Primary prevention, patients at high-risk (syncope, severe RV dysfunction, LV dysfunction...)

Exercise restriction, BB, ACEI

HYPERTROPHIC CARDIOMYOPATHY (HCM)

- Most common genetic cardiovascular disease
- Mutations in genes encoding for proteins of cardiac sarcomere
- Most common cause of sudden death in young, including competitive athletes
- **Thickened but non dilated LV in absence of other cardiac causes**
- Prevalence 0,2% 1:500
- **Autosomal dominant** – 11 genes encoding for contractile myofilament protein of sarcomere
- Disorganized architecture of myocytes + replacement with fibrosis in 95% HCM
- Abnormal intramural coronary arteries and narrow lumen in 80% patients at autopsies
- F = M (Women have greater risk of progression in advanced HF)
- Delayed diagnosis in women and people from African-American origin

LV hypertrophy

- Diagnosis with 2D-TTE, with CMR as complementary modality
- Diffuse in 50% patients
- Diverse patterns of asymmetric LV hypertrophy – different regions of LV wall are of greater thickness, with expansion to RV
- **Apical form**: wall thickening of distal portion of LV = **“ACE OF SPADE SHAPE”**
 - **More common in Japan**
- Normal mass in 20% cases when LVH is segmental and localized

Phenotype

- Incomplete until adolescence – accelerated growth and maturation accompanied by striking increase in LV thickness

Mitral valve apparatus

- Structural abnormalities responsible for LV outflow obstruction
- Elongation of both leaflets

LV outflow obstruction

- Basal gradient **≥ 30 mm Hg** is a strong determinant of progressive heart failure symptoms and CV death
- Weak association between LVOT obstruction and sudden death in patients without significant HF symptoms
- ↑ LV intraventricular pressure by subaortic obstruction = ↑ wall stress and oxygen demand
- Obstruction by SAM of mitral valve and midsystolic ventricular septal contact (elongated leaflet) – drag effects
 - Severity of gradient related to duration of mitral valve – septal contact
- MR due to SAM directed **posteriorly**
- Gradients are DYNAMIC
 - ↑: Valsalva, nitro, hypovolemia and dehydration, tachycardia, exercise, dobutamine, PVC

- ↓: BB, squatting, handgrip, phenylephrine

Hemodynamic state	Conditions	Outflow gradient
Basal obstruction	Rest	≥ 30 mm Hg
Non obstructive	Rest	< 30 mm Hg
	Provoked	< 30 mm Hg
Labile obstruction	Rest	< 30 mm Hg
	Provoked	≥ 30 mm Hg

Myocardial ischemia

- Microvascular dysfunction promotes scarring and remodeling

Diastolic dysfunction

- 80% patients with HCM: impaired LV relaxation
- Contributes to symptoms
- Increase contribution of atrial systole to overall LV filling
- DOES NOT predict prognosis

Family screening

- Echo + ECG (+ MRI is superior for detection of LVH)
- Starts at 12 years old – every 12-18 months
- Until 18-21 years old (full growth) if absence of LVH
- Screening every 5 years after (**delayed conversion to LVH in some patients**)

Genetic testing

- May detect a gene in 40-60% patients
- Gene **MYH7** – β-myosin and **MYBPC3** – myosin binding protein C = majority of cases (70%)
- **1st screening family members**

★ **Suggested reference:** Gollob MH et al. Recommendations for the use of genetic testing in the clinical evaluation of inherited cardiac arrhythmias associated with sudden cardiac death: Canadian cardiovascular society/Canadian heart rhythm society joint position paper. Can J Cardiol 2011;27 :232-245.

PHYSICAL EXAM

Jugular

- Large A wave – presystolic accentuation of atrial contraction

Rapid rise of carotid

- **bisferiens** (2 spikes in systole)
- **spike and dome**
- **brisk**

Palpation of the apex

- Double impulsion (end diastolic – systolic)
- Triple impulsion (end diastolic – systolic - protodiastolic)

Sounds

- S1 N
- S2 N / **paradoxal S2**
- S4 +/- B3

Murmur

- **Mid systolic murmur**
 - Crescendo – decrescendo
 - Max at apex and LLPS boarder
 - Variation in intensity
 - Systolic murmur 3/6 correlates with gradient > 30 mmHg
- **MR murmur in 50% cases**
 - Mid systolic
 - Soft and low frequency
 - Heard at apex
 - Right parasternal border irradiation

THE EXAM CAN BE COMPLETELY NORMAL DEPENDING ON THE HEMODAMIC STATE OF THE PATIENT AT TIME OF THE EXAM !

SYMPTOMS

- Chest pain
- HF
- Syncope

MANEUVERS

Maneuvers	Effect	AS	HCM	MR
Valsalva	↓Preload	↓	↑	
Muller	↑Preload	↑	↓	
Squatting	↑Preload, ↑afterload	-/↓	↓↓	↑
Standing	↓ Preload	↓	↑↑*	↓
Passive leg raising	↑ Preload	↑	↓	
Handgrip	↑ afterload	-/↓	-/↓	↑
VPB	↑ Preload	↑	↑	-/↓
Nitro ad 20s	↓ Preload, ↓ afterload	-	↑	↓
Nitro after 20s	↓ Preload, ↓ afterload et ↑Q	↑	↑	↓

***In standing after squatting, the systolic murmur sometimes doubles in intensity**

ATHLETES

- Increase LV diastolic dimension, wall thickness and mass
- Associated with high trained athletes doing sports like cycling or rowing, but not pure isometric sports
- Regression of wall thickness in 4-6 weeks of deconditioning
- Enlarged LV size > 55 mm
- HCM associated with sarcomeric protein mutation, altered LV relaxation and filling and LVED cavity < 45 mm
- USA: personal and family history + physical exam to all young athletes who wants to do competition

★ Suggested reference: Maron BJ and Maron MS. Hypertrophic cardiomyopathy. Lancet 2013;381 :242-55.

ELECTROCARDIOGRAM

- Abnormal in 90% proband (normal in 5% patients)
- Wide variety of patterns
- Increase voltages = **LVH**
- Marked T wave inversion in lateral precordial leads
- LA enlargement
- Deep Q waves
- Diminished R waves in lateral precordial leads

IMAGING

- **TTE and MRI**
- LV wall thickness (15 mm to 50 mm) predominant in anterior septum and free wall
- SAM (not always present) = **not obligatory for HCM diagnosis**
- Concentric symmetric LVH is very RARE

CLINICAL COURSE

- All phases of life
- **Mortality 1%/an**
- HF:
 - o Exertional dyspnea
 - o Only 10% patients with severe functional limitation (rare)
 - o Determinants of progressive HF are LVOT obstruction, AF, DD, microvascular dysfunction
 - o 3% end stage systolic dysfunction (rare)
 - o LV wall thickness not associated with higher risk of progressive HF symptoms
- Benign prognosis in gene carrier without LVH

SUDDEN DEATH: risk stratification

- Adolescents and young adults 30-35 years old
- Arrhythmias: VT and VF (occurrence ++ during sleep)
- Common in asymptomatic patients = 1st manifestation of the disease
- Occur in sedentary or during modest activity and among athletes
- Risk factors - **ICD**

- 1° prevention: family history or premature HCM related death, unexplained syncope, hypotensive or attenuated BP response to exercise, multiple NSVT on holter or ECG, massive LVH ≥ 30 mm
- 2° prevention: death or sustained VT
- *Other features*: CMR delayed enhancement (fibrosis – high risk VT), akinetic LV apical aneurysm with scarring and VT, end stage phase, alcohol septal ablation with transmural MI
- **LVOT obstruction and sudden death = relation is very WEAK**

MANAGEMENT

- ICD prevents death in **11%/year** (secondary prevention) and **4%/year** (primary prevention)
- Symptoms are due to **DD, LVOT obstruction, ischemia or all**
 - Slowing heart rate
 - Reduce force LV contraction and MVO_2 consumption
 - **BB** (Propranolol, atenolol, nadolol) inhibits sympathetic stimulation and blunt LVOT gradient triggered by exercise
 - **Verapamil** improves symptoms and exercise in patient without LVOT obstruction
 - **Dysopyramide** (3rd option)
 - Treatment of systolic heart failure
 - Careful with diuretics
- Surgery: **SEPTAL MYOMECTIONY**
 - Preferred option with severe drug refractory HF and disability associated with LVOT obstruction under basal and exercise conditions (gradient ≥ 50 mm Hg)
 - HF is reversible post-op
 - Resection of small portion of basal septum (Morrow procedure) or extended in the septum to 7 cm distally from Aortic valve
 - Mortality < 1%

★ Suggested reference: Fifer MA and Sigwart U. Hypertrophic obstructive cardiomyopathy: alcohol septal ablation. Eur Heart J 2011;32 :1059-1064.

- Dual pacing
 - Alternative to myomectomy for obstructive HCM with refractory HF = placebo
- **ALCOHOL SEPTAL ABLATION**
 - Alternative to surgery
 - 1-3 cc of 95% alcohol in a major septal perforator coronary artery to create necrosis and permanent transmural MI in the proximal ventricular septum = LVOT enlargement and reduction of LVOT gradient
 - Scar of 10% LV wall
 - For older patients, not candidate to surgery with comorbidity...
 - Complications: arrhythmias, death (3-5%)
- **PREGNANCY**
 - No increase risk during pregnancy of delivery
 - Mortality is very low, women more at risk with severe HF, VT or marked LVOT obstruction

- Normal vaginal delivery
- **Endocarditis** < 1% prevalence
 - Anterior mitral leaflet or septal endocardium
 - NO PROPHYLAXIS REQUIRED unless invasive dental procedure
- **AF**
 - 20% patients
 - ↑ Age and LA enlargement
 - Stroke (1%/year, prevalence 6%)
 - Progressive HF
 - ACO is mandatory
 - Amiodarone is the most effective drug for recurrent AF

Content of this summary from these references:

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