ABSTRACT

- Large number of patients with cardiomyopathy may be asymptomatic or only mildly symptomatic.
- Etiology is frequently genetic.
- Echocardiography is useful screening test for early diagnosis and gross sub-classification of cases.
- Echocardiography may be apparently “normal” in large number of cases specially in early stages when interventions may be useful.

At present echocardiography is not capable of making etiological diagnosis. MRI may be more useful.

At present echocardiography is not capable of correct evaluation of prognosis and risk of sudden death in large number of cases. Gene analysis & identification of exact mutation is more dependable and may become preferred mode of investigation in years to come.

NEW DEFINITION

“A heterogenous group of diseases of the myocardium associated with mechanical and for electrical dysfunction, which usually (but not invariably) exhibit inappropriate ventricular hypertrophy or dilatation, and are due to variety of etiologies that frequently are genetic. Cardiomyopathies are either confined to the heart or are part of generalized systemic disorders, often leading to cardiovascular death or progressive heart failure related disability”.

New classification - Emphasis on genetic determinants of Cardiomyopathies.

A. Primary – Solely or predominantly confined to heart muscle
   a. Genetic
      - Hypertrophic cardiomyopathy
      - Arrhythmogenic right ventricular cardiomyopathy
      - Left ventricular noncompaction

SR Mittal, Ajmer
- Glycogen storage.
- Conduction defects
- Mitochondrial myopathies
- Ion channel disorders
- Long QT syndrome
- Brugada syndrome
- Short QT syndrome
- Catecholaminergic polymorphic ventricular tachycardia
- Sudden unexplained nocturnal death syndrome

b. Mixed
   - Dilated cardiomyopathy
   - Restrictive cardiomyopathy-non hypertrophied, on dilated

c. Acquired
   - Inflammatory (myocarditis)
   - Stress provoked (“tako tsubo”)
   - Peripartum
   - Tachycardia-induced
   - Infants of insulin dependent diabetic mothers

B. Secondary - myocardial involvement as a part of systemic disorders
   a. Infiltrative – Amyloidosis, Gaucher’s disease, Hurler’s disease, Hunter disease
   b. Storage-Hemochromatosis, Fabry disease, glycogen storage disease, Niemann-Pick disease
   d. Inflammatory (granulomatous) sarcoidosis
e. Toxicity
   - Drugs, heavy metals, chemical agents
   - Endomyocardial fibrosis
   - Hyper eosinophilic syndrome
   - Loffler endocarditis
f. Endocrine- Diabetes mellitus, Hyperthyroidism, Hypothyroidism, Hyperparathyroidism, Pheochromocytoma, Acromegaly
g. Cardiofacial -Noonan syndrome, Lentiginosis
h. Neuromuscular-Friedreich ataxia, Duchenne-Becker muscular dystrophy, Emery–Dreifuss muscular dystrophy, Myotonic atrophy, Neurofibromatosis, Tuberous Sclerosis
i. Autoimmune/collagen
   SLE, Dermatomyositis, Rheumatoid arthritis, Scleroderma, Polyarteritis nodosa
j. Electrolyte imbalance
k. Consequence of cancer therapy
   - Anthracyclines, Cyclophosphamide, Radiation
     However, for the purpose of clinical and echocardiographic evaluation, I will use the old classification
   - Dilated cardiomyopathy
   - Hypertrophic cardiomyopathy
   - Restrictive cardiomyopathy.

DILATED CARDIOMYOPATHY 1,4

Diagnostic criteria—Ventricular chamber enlargement, systolic dysfunction, normal
LV wall thickness

CLINICAL EVALUATION

New information
• Patients may be asymptomatic or mildly symptomatic
• Family screening may reveal asymptomatic siblings
• Exact etiology may not be clear in more than 50% cases inspite of endomyocardial biopsy
• Several agents considered as etiological may only be precipitating factors in a susceptible host. Large number of patients may have more than one precipitating factor
• Preventable/ potentially reversible Etiological / Precipitating factors
• Occult CAD
• Chronic excess alcohol consumption >80 gm/ day for male, >40 gm/ day for female (for more than 5 years) Heavy beer drinking can result in thiamin deficiency particularly in presence of deficient diet.
• Peripartum - Unpredictable course. Should never become pregnant again even if myocardial functions have recovered fully
• Chronic uncontrolled hypertension >160/100 for years
• Antineoplastic agents
• Doxorubicin-
   • Acute – not dose dependent, myopericarditis syndrome, Arrhythmias, conduction abnormalities, Non specific ST- T abnormalities. LV dysfunction is rare
   • Chronic- Cumulative dose more than 350 mg/m sq. Cardiac toxicity may appear months or year after last dose Concomitant radiation or use of other neoplastic agents also contribute.
   • Cyclophosphamide- Acute,not related to cumulative dose, pericarditis, arrhythmias, systolic dysfunction.
   • Antiretroviral drugs, Lithium, clozapine, cocaine
   • Hypothyroidism, Thyrotoxicosis, Diabetes, Acromegaly, Cushing syndrome, Pheochromocytoma, Catecholamines, Hypocalcemia, Hypophosphatemia
   • SLE, Juvenile rheumatoid arthritis, Polyarteritis nodosa, Collagen vascular diseases –
   • Scleroderma, Lupus erythematous, Dermatomyositis
   • Interferon -alpha, Interleukin-2
   • Allergic reaction to drugs
     - Penicillin, Sulfonamides, Ampicillin, Tetracycline
     - Antitubercular
     - Sulfonylurea
     - Phenobarbital, Carbamazepine, Phenytoin
     - Methylodopa
     - Peripheral eosinophilia with acute necrotizing myocarditis
   • Nutritional deficiencies – Thiamine (Beri-Beri), Vitamin D, Selenium, Carnitine, Total parenteral nutrition.
   • Viral myocarditis may present only with ST-T abnormalities, prolonged QTc or ventricular arrhythmias
   • Chaga disease -AV block, RBBB with or without fascicular block
   • Tako Tsubo Cardiomyopathy (Stress cardiomyopathy)
     - Acute but reversible LV systolic dysfunction. Preceded
Cardiomyopathies—Clinical and Echocardiographic Evaluation

Echocardiographic Evaluation

New Information

- Asymptomatic patients or relatives may have ventricular dilatation, systolic dysfunction or segmental wall motion abnormalities
- Dilatation may initially be minimal (within upper limits of normal) and follow up studies may be required for diagnosis.
- Scars indistinguishable from chronic ischemia may be present
- Intracardiac thrombi and mural endocardial plagues (from organization of thrombi) are associated with more frequent systemic & pulmonary emboli.
- Viral myocarditis - Wall thickness can be increased, particularly early in the course of disease, when inflammation is fulminant
- Chagag disease – segmental wall motion abnormalities especially apical aneurysm
- Tako Tsubo Cardiomyopathy - mildly or severely decreased LV function with antero apical akinesia or dyskinesia, Apical ballooning with basal LV hypercontractile Mitral regurgitation, Thrombus formation
- Non compaction - Multiple prominent ventricular trabeculation with deep recesses and blood flow through these crevices in continuity with LV cavity
- Tachycardia cardiomyopathy - Normalization without residual impairment on cessation of Tachycardia

Hypertrophic Cardiomyopathy (HCM)

Clinical Evaluation

New Information

- Most of the patients are completely asymptomatic.
- Sudden death may be the first presentation.
- Risk factors for sudden cardiac death.
- Major- previous cardiac arrest or spontaneous sustained VT.
- Minor- Family history of premature sudden cardiac death caused by HCM
- Repetitive non-sustained VT
- LV thickness >30 mm
- Inability to augment and sustain systolic BP during exercise
- Repetitive syncope
- Screening of all first degree relatives is recommended every 2-5 years
- Diuretics and vasodilators used for management of concomitant hypertension may aggravate LVOT obstruction
- Patients with dynamic LVOT obstruction should have infective endocarditis prophylaxis
- Patients with LBBB have greater risk of developing complete AV block during septal ablation

Echocardiographic Evaluation

New Information

- Hypertrophy need not be confined to interventricular septum and LV apex but may involve any part of LV.
- In older patients hypertrophy is localized to the mid and basal septum. Apical part of septum remains concave in contour (sigmoid septum)
- ECC alterations may precede appearance of hypertrophy on echocardiography.
- Normal LV wall thickness does not exclude presence of a HCM causing mutant gene.
- With incomplete penetrance development of LV hypertrophy may be delayed up to adulthood or even 50 to 60 year.
- Abnormally low annular velocities may help detect subclinical disease in patients who carry an HCM associated genetic abnormality but have not developed increased wall thickness.
- Patients with mild hypertrophy may still be at risk of sudden death.
- Echocardiographic signs of dynamic LVOT obstruction may not be present at rest and may appear only on provocation.
- Posterior mitral leaflet and chordal apparatus or hypertrophied papillary muscle may also show systolic anterior motion and may contribute to LVOT obstruction at different levels
- Echocardiography is useful in ruling out other causes of LVOT obstruction and evaluating additional
- Intrinsic disease of mitral valve apparatus (prolapse or flail) that are likely to affect subsequent treatment options
- Mitral regurgitation jet secondary to SAM in patients with HCM is directed laterally and posteriorly and predominates in mid to late systole. A holosystolic signal directed centrally or anteriorly should raise suspicion of primary abnormality of mitral valve apparatus
DIFFERENTIAL DIAGNOSIS

- Athlete's heart – difficult diagnostic challenge. Findings that support possibility of athlete’s heart
- Dilated ventricular cavity
- Septal thickness < 15mm
- Preserved or enhanced annular velocities
- Reduction in wall thickness after cessation of training
- Chronic renal failure specially those on dialysis
- Infiltrative forms of LV hypertrophy
- Amyloidosis –
- Decreased voltage on ECG

Echo
- Symmetrical wall thickness involving LV & RV
- Variable but often depressed systolic function
- Small pericardial effusion
- Thickening of inter atrial septum, atrioventricular valves and enlarged papillary muscle.
- Highly reflective echoes producing a granular or sparkling appearance – neither sensitive nor specific. LVH due to hypertension, Aortic stenosis,
- Idiopathic hypertrophic cardiomyopathy, Hemochromatosis may show speckled appearance where as amyloid cardiomyopathy may not show this finding.
- Earliest sign on doppler evaluation is impaired relaxation ; Restrictive pattern appears later
- Poor Prgnosis – Primary amyloidosis, H/o syncope, Evaluation of Trop I & T at the time of diagnosis

- Primary cardiac glycogen cardiomyopathies
- Pompe disease
- Fabry disease

RESTRICTIVE CARDIOMYOPATHY

Diagnostic criteria
Heart failure with normal or decreased volume of both ventricle (generally < 110 ml / m²), biaatrial enlargement, normal LV wall thickness, normal AV valves, impaired ventricular filling with restrictive physiology & normal or near normal systolic functions of both ventricles

Clinical Evaluation

New information
- Differentiation from pericardial constriction remains a challenge due to considerable overlap in clinical features. Further the two entities can coexist after myocardial irradiation & after coronary artery bypass grafting.
- Intense eosinophilia can suggest hyperesinophilic syndrome. It can be related to parasitic infection, leukemia or immunological reaction.

Echocardiographic evaluation

New Information
- Differentiation from pericardial constriction
- Remains a challenge due to considerable overlap in echo finding
- Pericardial thickness of > 4mm on MRI or CT, large respiratory changes in septal
- Excursion on real time CINE MRI and normal BNP levels are supportive of pericardial
- Constriction
- Echocardiography can not distinguish between different etiologies.
- MRI can be useful because of its capability of tissue characterization
- Endomyocardial fibrosis
- Echocardiography can be normal in acute necrotic stage. Classical picture of endocardial
- Thickness and calcification obliteration of apex and subvalvular regions of one or both ventricles and mural thrombi appear much later.
- Carcinoid syndrome
- Echocardiography may be apparently normal in initial stage when extracardiac manifestations (cutaneous flushing, diarrhea, bronchoconstriction) are already present.
- Initial findings include fibrous endocardial plaques on Tricuspid and pulmonary valve and right heart endocardium
- Thickened, retractile, immobile Tricuspid & pulmonic valves with stenosis or low pressure regurgitation are late finding .Unlike congenital PS, post stenotic dilatation of pulmonary trunk does not occur.
- Gaucher’s disease- Left ventricular thickening, left sided valvular thickening & pericardial effusion are common.
- Hemochromatosis – can produce granular sparkling on echocardiography.
Cardiomyopathies–Clinical and Echocardiographic Evaluation

• Sarcoidosis
  - Localized thinning & dilatation of basilar LV resembling IHD
  - Pulmonary artery hypertension & RV failure are common
  - Restrictive pattern is uncommon.
• Pseudoxanthoma elasticum – calcified endocardium & echo dense pericardium
• Progressive systemic sclerosis- Pericardial involvement, Pulmonary artery hypertension

Cardiomyopathies presenting with significant ECG abnormalities or arrhythmias but without diagnostic echocardiographic finding

Cardiomyopathies Producing ventricular tachycardia, syncope, sudden death
• Catecholaminergic polymorphic VT
  - Normal resting ECG Triggered by vigorous physical exertion or acute emotion
• Short QT Syndrome
  - QT <330 m.s Tall peaked T waves like those seen with hyperkalemia.
• Long QT Syndrome
  - Prolongation of QT interval corrected for heart rate
  - Congenital -25 to 50% effected family members with genetic abnormality may have borderline or even normal QT
• Brugada Syndrome
  - Classical- RBBB with coved ST segment elevation in leads V1-V3
  - ECG pattern is often concealed and may be unmasked by sodium channel blockers eg., Ajmaline, flecainide, Procainamide, Pilsicainide.
• Arrhythmogenic right ventricular cardiomyopathy
  - Life threatening ventricular arrhythmias (classically monomorphic VT with LBBB morphology) occur frequently without any echocardiographic abnormality.
  - MRI is more sensitive than echocardiography
  - Regional or global wall motion abnormalities or dilatation of right ventricle may appear later.
  - 50 to 75% of patients may have left ventricular involvement.
• Inflammatory myocarditis
  - Cocaine, Giant cell myocarditis, Hypersensitivity reaction to drug.

Cardiomyopathies Producing conduction defects & syncope
• Lenegre disease
• Progressive systemic sclerosis
• A-V block, SVT, VT, Pseudo infarct pattern
• Sarcoïdosis
• High degree AV block, ventricular arrhythmia
• Chaga disease
• A-V block, RBBB with or without fascicular block.

REFERENCES