Left Ventricular Noncompaction: A Brief Review

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Abstract

Left ventricular noncompaction (LVNC) is known by different names like noncompaction of ventricular myocardium, and ventricular trabeculation([1]) .WHO classifies LVNC as unclassified cardiomyopathy([1,2,3,4,5])

ETIOPATHOGENESIS

LVNC is a rare type of cardiomyopathy characterized by spongy myocardium and results from arrest in endomyocardial morphogenesis. In the early embryonic period human heart consists of spongy meshwork of interwoven muscle fibers and trabeculae. These communicate through recesses with the ventricular cavity. The blood is supplied to the myocardium through these trabeculae resembling the circulation of nonmammalian vertebrates([6, 7]). During sixth to eighth week of intrauterine life human heart undergoes compaction of this loose and honeycomb structure. The process of compaction proceeds from epicardium to the endocardium and from base to the apex. Arrest of compaction results in persistence of trabeculation and deep recesses([7]). Noncompaction is usually isolated but rarely occurs in association with anomalous left coronary artery from pulmonary artery (ALCAPA), complex cyanotic heart diseases, right ventricular outflow tract and left ventricular outflow tract obstruction and Eibsteins anomaly([8,9,10,11,12]). It may be associated with Beckers and mitochondrial myopathy ([13,14,15,16,17,18,19]).

The exact mechanism that leads to arrest of compaction is unclear but familial and genetic basis in some cases has been proposed ([20,21,22]). Familial cases account for almost 18% to 50 % of cases in various published series of cases. The inheritance in majority of such cases was autosomal dominant. X linked or mitochondrial transmission was also seen in few families([20,21,22,23]).

There are many studies done in the recent past that showed the genetic basis for left ventricular noncompaction. Various genes have been associated with LVNC.

1. G4.5: This gene is located on Xq28 and was initially described in patients with Barth syndrome, some of whom were found to have Noncompaction of ventricular myocardium(20, 22, 24,25,26). Taffazins are products of G4.5 gene and are expressed in heart and muscle cells and their action is thought to take place in mitochondria(27, 28).

2. FKB12: This gene modulates the release of calcium from sarcoplasmic reticulum by the ryonidine receptor 2, deletion of this gene mice models results in cardiomyopathy with features of noncompaction.(7, 22, 29)

3. Alpha-Dystrobrevin: this gene was identified in Japanese with six members affected by NVM. Other genetic defects associated with NVM include mutations of LamininA/C, transcription factors NKX2.5 TBX5 .the locus 11p15 is associated with autosomal dominant NVM(20, 22, 26, 30).

CLINICAL MANIFESTATION

The clinical manifestation of LVNC are not specific and include some major complications([31]).The common manifestations of LVNC are heart failure (53%), ventricular tachycardia (41%) , sudden cardiac death (35%), cardioembolic events (24%) and syncope (18%)([31,32]) .Ventricular arrhythmias are major and sometimes fatal complications in patients with LVNC([32]). Other arrhythmias like atrial fibrillation and ventricular premature complexes were also found in patients with LVNC. Among children wolf parkinson white (WPW) pattern with or without supraventricular tachycardias is common. Signal averaged ECG(SAECG) reveals low amplitude late potentials in these

patients, according to some authors the presence of late potentials correlate with disease severity and extent([33,34,35]).

Cardioembolic events occur independent of cardiac dimensions and function. The high prevalence of such events is thought to be due to development of mural thrombi within deep intertrabecullar spaces([36, 37]). Nonspecific dysmorphic features like prominent forehead, strabismus, low set ears and micrognathia are observed in some children([38, 39]).

DIAGNOSTIC CRITERION

Diagnosis can be made by echocardiography. Current echocardiograpic criterion for diagnosis typically includes the following three([40,41,42,43,44]).

a) Presence of multiple echocardiographic trabeculations, particularly in the apex and free wall of the left ventricle.

b) Multiple deep intertrabecullar recesses communicating with the ventricular cavity as demonstrated by color Doppler imaging.

c) Two layered structure of the endomyocardium with an increased noncompacted to compacted ratio (>2.0 in adults and >1.4 in children.).

The proportion of ventricular wall involvement (50%) is also used in the definition of LVNC by some authors .Some authors exclude the diagnosis of LVNC when other anomalies are also present.

Magnetic resonance imaging studies can be diagnostic especially when good echocardiographic pictures are not possible([14, 45, 46]).

ECG findings commonly seen include signs of biventricular hypertrophy with extreme QRS voltage, isolated or diffuse T wave inversions ,WPW pattern with or without SVT, and conduction abnormalities including heart blocks([33, 47]).

Genetic testing for known mutations can provide additional data for counseling and research .3 methylgluconic aciduria and neutropenia is seen in Barths syndrome .Skeletal muscle biopsy can provide evidence of inclusion and myopathic changes.

DIFFERENTIAL DIAGNOSIS

LVNC should not be confused with normal heart having prominent left ventricular trabeculations .Upto three trabeculations can be seen in normal variants .Other conditions that can be confused with apical hypertrophic cardiomyopathy, dilated cardiomyopathy, arrythmogenic right ventricular dysplasia, endocardial fibroelastosis and cardiac metastasis. A trained and aware echocardiogragher can provide diagnosis in most cases. Magnetic resonance can also provide additional and at times crucial information when the diagnosis is not confirmed by echocardiography.

PROGNOSIS

The ultimate outcome of patients remains unclear([48]). Short of cardiac transplant treatment is symptomatic with anti-heart failure regimens. Cardiac resynchronization has been tried with variable results([49]). Anticoagualtion for patients with mural thrombi and/or embolic phenomenon is indicated, however there is no evidence supporting the role of prophylactic use of anticoagulants([50]). Cardiac defibrillators have been used in patients with aborted sudden cardiac death([51]).

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