CASE REPORT AND REVIEW

A Dying Young Man: Non-compaction Cardiomyopathy: A Case Report and the Literature Review

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ABSTRACT

A young man was found to have cardiac arrest while sleeping. Eventually a rare diagnosis of non-compaction cardiomyopathy was made.

Key words: Sudden cardiac death, non-compaction cardiomyopathy, two-dimensional echocardiography

INTRODUCTION

Left ventricular non-compaction (LVNC) cardiomyopathy is characterized by prominent ventricular trabeculations and deep intertrabecular recesses in communication with the LV cavity.[1] It is a pathophysiologic process involving the arrest of the normal compaction of the embryonic sponge-like meshwork of interwoven myocardial fibers. Failure of this process leads to a thin, compacted epicardial layer, and an extensive non-compacted endocardial layer.[2] This absence of LV compaction is highly associated with the development of heart failure, cardiac arrhythmia, and thromboembolism.[3]

The first description of spongy myocardium in the literature was reported in 1975 by Dusek *et al*., however, it was recognized and described by a two-dimensional (2D)-echocardiography the 1st time in 1984 by Engberding and Bender.[4,5] As a matter of fact, the 1st case of LVNC was described by Feldt *et al*. in a 3-month-old baby with cyanotic heart disease and dextrocardia in whom a spongy inner layer and a compact outer layer of myocardium was noted.[6]

The prevalence of this disease ranges from 0.05% to 0.25%, and males are more commonly affected than females.[7,8]

This is a rare disorder that could occur in isolation or with other congenital heart diseases. It could remain asymptomatic or could present with heart failure, palpitations, arrhythmia, thromboembolic phenomena, or sudden cardiac death. Mean age of diagnosis for this condition in adults at 40 years and in children around 7 years.[9]

CASE REPORT

A 34-year-old pleasant physically very active man one night while sleeping, his wife noted that he was turning blue and had stopped breathing! The paramedics were called and he was shocked 4 times. He was started on intravenous amiodarone. He was noted in the emergency room to be in atrial fibrillation with a rapid ventricular response. He was shocked once more and cardioverted to normal sinus rhythm. He was intubated and placed in the hypothermia protocol.

After rewarming and recovery in the intensive care unit, he underwent a diagnostic coronary angiography, which revealed normal epicardial coronaries.

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QUESTIONS

There are so many questions that arise from a patient like this:

1. A young active man with no medical or cardiac diseases was turning blue and stopped breathing in his sleep!! Why? How often this happens? Did he have anything like this before? Would he have died, if his wife was not next to him? Would he have died in an another country where 911/paramedics and advanced health care not available to many people?
2. Should his wife not have started the cardiopulmonary resuscitation (CPR)? Was she trained or did she know anything about CPR? How about teaching the very basics of CPR to the general population at large?

He underwent a 2D-echocardiographic study, which revealed severe global LV dysfunction with an ejection fraction of 20–25%. There were findings suggestive of a restrictive filling pattern of the left ventricle (Stage III diastolic dysfunction). Both atria were mildly enlarged. Pulmonary pressure could not be calculated. There was a small pericardial effusion. LV thrombus could not be ruled out.

Based on these findings, he was advised to undergo cardiac magnetic resonance imaging (MRI) which revealed: Moderately dilated left ventricle. Severe trabeculations and thinning of both the distal, mid, and apical portions of the left and the right ventricles. The trabeculated non-compacted to compacted myocardium with a ratio of 3:1. No thrombus noted. Diffuse global LV and right ventricular hypokinesis with an overall LVEF of 30–35%.

MORE QUESTIONS

1. What is non-compaction myocardium/ventricles? Most internists and family physicians rightfully will not be aware of this rare entity. Cardiologists know about this condition and have read during their training/fellowship. Many will not know the details about this condition simply because it is a rare condition seen in clinical cardiology practice
2. Is there any way we can screen for this condition?
3. Are there tests available to the doctors and the families that can be done to make a diagnosis before a person presents with congestive heart failure or sudden cardiac death?

CASE REPORT CONTINUATION

Electrophysiology consultation was placed and based on his presentation (sudden cardiac arrest/ventricular fibrillation and diagnosis LV non-compaction cardiomyopathy), a defibrillator was placed. His hospitalization was unremarkable and he was seen in my office for follow-up and defibrillator interrogation.

GENETICS OF LVNC

There is no single gene abnormality causing LVNC; however, there are multiple genes implicated in its causation and therefore a family history of cardiomyopathies and familial genetic screening is recommended as Class I as per the Heart Rhythm Society when a mutation-specific gene has been identified in the index case.[10] Familial occurrence rate could be in the range of 30% and the sporadic occurrence for up to 60–70%.[11] Many cases could be autosomal dominant, some autosomal recessive and a very few have X-linked inheritance (G4.5 gene).[12]

Some of the commonly implicated genes in this condition are: Fbkpla/Notch pathway, G4.5 gene/TAZ protein, 14-3-3 deletion, ZASP protein, MYH7 protein, and many more.

Some experts believe that acquired pathogenesis is possible in people with prior normal structure and function of the heart developing LVNC later in life and this goes along with the theory that LVNC might represent a morphological continuation of genetic cardiomyopathies, for example, dilated or hypertrophied cardiomyopathies.[13]

DIAGNOSTIC CRITERIA

Diagnosis of this condition is mostly based on imaging criteria, the most common being the trans-thoracic echocardiography features. There are three proposed diagnostic criteria mentioned in the literature.[14]

Initial diagnostic criteria were suggested by Chin *et al*.[2] (a) increasing LV free wall thickness from base to apex at end-diastole, (b) prominent trabeculations with deep recesses, and (c) decrease in ratio from mitral valve level to papillary muscle level of the distance from the epicardium to the trough of the trabeculations (X) to the epicardium to the peak of the trabeculations (Y) (X/Y <0.5).

Subsequently, these criteria were refined and improved by Stollberger and Finsterer[15] (a) more than three trabeculations protruding from the LV wall apical to the papillary muscles, (b) two-layered myocardium in which the non-compacted layer is thicker than the compacted myocardium, and (c) perfused intertrabecular spaces.

Finally the Jenni[16] criteria (a) bi-layered myocardium with multiple, prominent trabeculations at end-systole, (b) a non-compacted to compacted ratio of >2, (c) communications with the intertrabecular space with color Doppler, and (d) absence of coexisting cardiac abnormalities. These criteria appear to be much more reliable for its diagnosis.

Recently, some other criteria are being looked for better diagnosis, including speckle tracking and three-dimensional imaging.[17]

In addition to all these echocardiographic features, cardiac MRI allows better differentiation between the compacted and the non-compacted myocardium. These features include: Better spatial resolution, better apical imaging, and late gadolinium enhancement.[18,19] Late gadolinium enhancement correlates well with fibrosis.

Two MRI criteria worth mentioning here are (1) non-compacted to compacted segment ratio of >2.3[19] and (2) LV trabecular mass >20% of total LV mass.[20]

MANAGEMENT

There are at least following perspectives related to this diagnosis that needs to be addressed and managed:

Heart failure

Most of these patients will need management of their symptoms like any other condition leading to heart failure with a beta-blocker, angiotensin-converting enzyme inhibitors, diuretics, digoxin, and consideration for heart transplant, if and when indicated.[21]

Anticoagulation

The risk of stroke in these patients is 1–2% per year or a total risk of thromboembolism is 21–38%.[22] Prevention of systemic embolization is a serious consideration; however, the literature is unclear and without data regarding anticoagulation in the absence of atrial fibrillation and preserved LV systolic function. Oechslin *et al*.[13] recommended anticoagulation for patients with an LVEF of <40%. Long-term anticoagulation is recommended in all of these patients regardless of the symptoms or the presence of intracardiac thrombi.[23,24]

Arrhythmia/sudden cardiac death

Arrhythmia monitoring is always recommended in these patients given a high risk of ventricular arrhythmias. Electrophysiological testing to predict the risk of sudden cardiac death has not been very helpful. Kobza *et al*.[25] demonstrated in a series of 30 patients with this condition who received implantable cardioverter-defibrillator (ICDs) or BiV ICDs for secondary prevention, the appropriate ICD therapy occurred in 37% of cases with a mean follow-up of 2 years. In patients received ICD therapy for primary prevention, 33% had appropriate ICD therapy with a mean follow-up of 2 years. The decision to implant a defibrillator (ICD) or biventricular defibrillator (BiV ICD) is clear in patients who have survived a cardiac arrest or in patients with LVEF <35% who qualify for an ICD or BiV ICD according to the current guidelines.[26]

Genetic counseling

Genetic counseling and clinical screening of first-degree relatives up to three generations is recommended. Clinical screening that includes history, physical examination, electrocardiography, and 2D-echocardiography should be performed every 3 years beginning in childhood if genetic testing is negative.[27] The role of genetic testing remains undefined at this time.

CONCLUSIONS

LV non-compaction is a rare familial disease that can lead to heart failure, systemic embolization, and sudden cardiac death. It poses a great challenge due to a lack of precise diagnostic criteria or management guidelines. Family members need to screen as it can be inherited in an autosomal dominant or autosomal recessive pattern. It can also be associated with some neuromuscular disorders and therefore neurological evaluation needs to be considered from time to time.

COMMENTARY

Thank god this man is alive and now on an anticoagulant and defibrillator in place, and he and his family are happy. However, I wish we are at the point of medical capabilities where we could have most diagnosed at birth or soon thereafter with the help of blood tests, genetic evaluation, or some other means. Or else how easy yet how difficult it would have been for this young man to lose his life had his wife was not with him at the time!

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How to cite this article: Mishra S, Mishra A, Mishra JP. A Dying Young Man: Non-compaction Cardiomyopathy: A Case Report and the Literature Review. J Clin Cardiol Diagn 2019;2(2):1-4.