Case report

LEFT VENTRICULAR NON-COMPACTIONCARDIOMYOPATHY: CASE REPORT AND REVIEW OF LITERATURE

ABSTRACT

Non-compaction cardiomyopathy (NCC) is characterized by trabeculations in either one or both ventricles [1]. Clinical presentation is highly variable: dyspnea, palpitation, thromboembolic events, arrythmia or sudden cardiac death. There are currently no universally-accepted criteria for classifying and diagnosing left ventricular non-compaction(LVNC) cardiomyopathy. Transthoracic echocardiography (TTE) has been the diagnostic exam of choice, while the diagnosis is often missed or delayed because of lack of knowledge about this uncommon disease. Progression of LVNC is highly variable and prediction of prognosis is very difficult.

We report a case of a 50-year-old female with a history of total thyroidectomy under hormonal supplementation who consults fordyspnea and paroxysmal palpitations revealing an isolated LVNC.

This case emphasizes the importance of imaging techniques, which are, TTE and cardiac magnetic resonance imaging (MRI) in early diagnosis, management, and follow-up.

Keywords: cardiomyopathy, left ventricular non-compaction cardiomyopathy,cardiac magnetic resonance imaging, ventricular trabeculations, spongy myocardium.

1. INTRODUCTION

Non-compaction cardiomyopathy (NCC), also called “spongy myocardium”, is a rare genetic disorder characterized by trabeculations in either one or both ventricles [1]. NCCis found on transthoracic echocardiography (TTE)and/or cardiac MRI. This rare disease is associated with thromboembolism and an increased risk of ventricular thrombus formation and even sudden death.

Clinical presentation is highly variable,and can range from asymptomatic disease to symptomsof, bundle branch blocks, sudden cardiac death including palpitations, chest pain, shortness of breath, cerebrovascular accidentsrevealing heart failure, thromboembolism, and atrial or ventricular arrhythmias.There are currently no universally-accepted criteria for classifying and diagnosing left ventricular non-compaction (LVNC) cardiomyopathy.

Left ventricular non-compaction (LVNC) cardiomyopathyisthought to be caused by arrest of normal embryogenesis of the endocardium and myocardium. It may be associated with other congenital cardiac defects.

We report a case of a 50-year-old female with a history of total thyroidectomy under hormonal supplementationwho consults fordyspnea and paroxysmal palpitations revealing an isolated left ventricular non-compaction (LVNC) cardiomyopathy suspected in transthoracic echocardiography(TTE)and confirmed with cardiac MRI.

2. CASE PRESENTATION

A 50-year-old female with a past medical history of total thyroidectomy under hormonal supplementation who consults fordyspneafortwo monthsprior without any aggravating or alleviating factors. She also complained of more frequent and sustained episodes of rapid palpitations associated with shortness of bf@reath. There was no family history of cardiomyopathy.

Physical examination found a stable patient, with a blood pressure of 138/78mmHg and heart rate of 73 beats per minute.An electrocardiogram (ECG) demonstrated normal sinus rhythm and normal axis, and repolarization disorders with negative T waves in aVLand DI leads. Biological assessment shows anormal troponin level as well as normal renal and liver function tests.

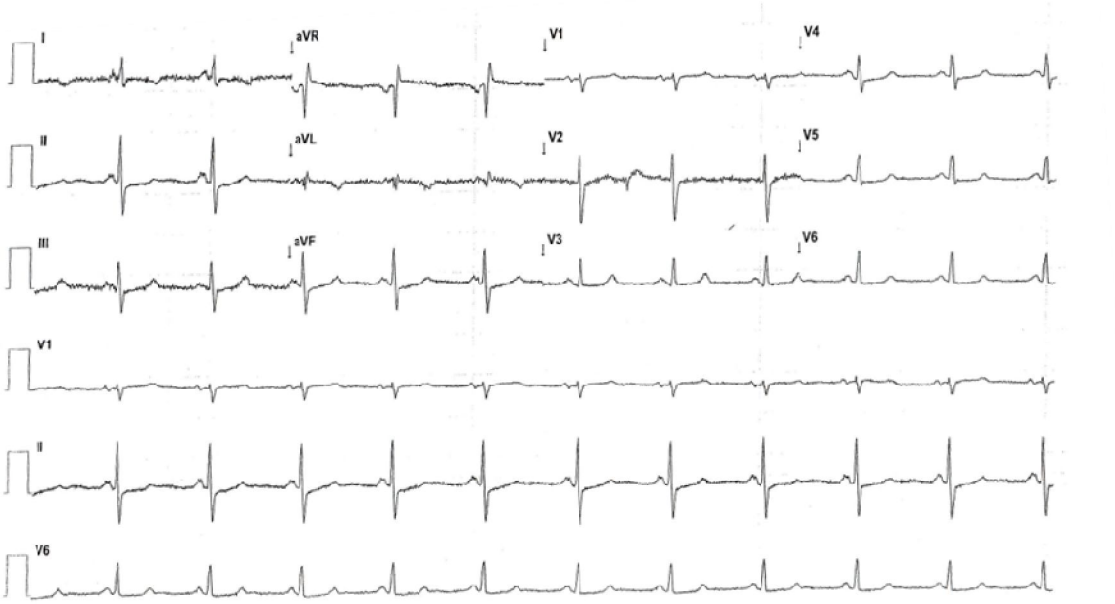

Fig. 1. Twelve-lead ECG shows sinus rhythm, normal QRS duration, and negative T-wave flattening in aVL, DI

A TTE was performed demonstratingmarked thickening trabeculation of left ventricle predominantly at the apex but also in the apical and mid portion of the lateral and anterior wall. Colour doppler displayed flow within the deep intertrabecular recesses.The left ventricle was not dilated with a mildly reduced ejection fraction, left ventricular ejection fraction (LVEF) of 45%. The right ventricle was normal. No additional abnormalities were seen. These echocardiographic findings were concerning for an isolated LVNC(Figures 2-3).A cardiac catheterization did not reveal evidence of obstructive coronary artery disease. Twenty-four-hour Holter monitoring identified frequent premature ventricular contractions.

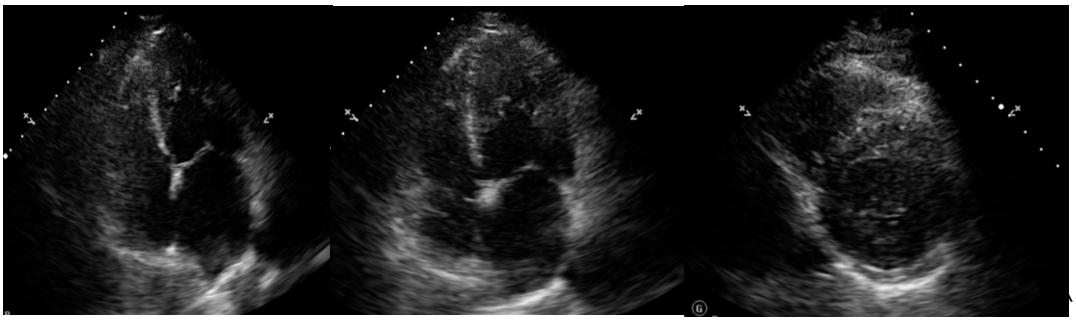

Fig. 2.2D echocardiography: apical four-chamber (A4c) and short axis showing trabeculation of the apex, the medium and apical segment of the interventricular septum, andthe lateral wall.

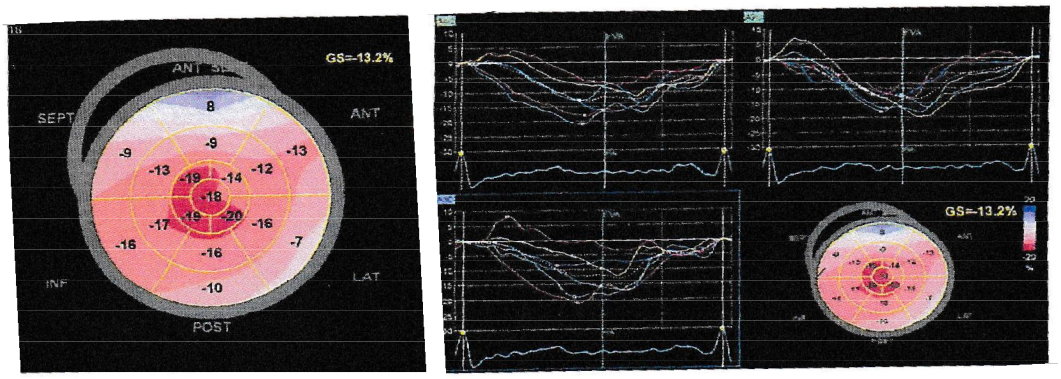

Fig. 3.2D speckle tracking echocardiography

Given the strong suspicion of non-compaction, a cardiac MRI was indicated and it demonstrated trabeculated aspect of the papillary muscles, hypertrabeculation of the left ventricle with a ratio of non-compacted to compacted myocardium of 2.7. The tagging sequence showed an alteration of the intrinsic contractility of the anterior wall. There was no late gadolinium enhancement suggestive of myocardial infarction or fibrosis. (Figures 4-5).

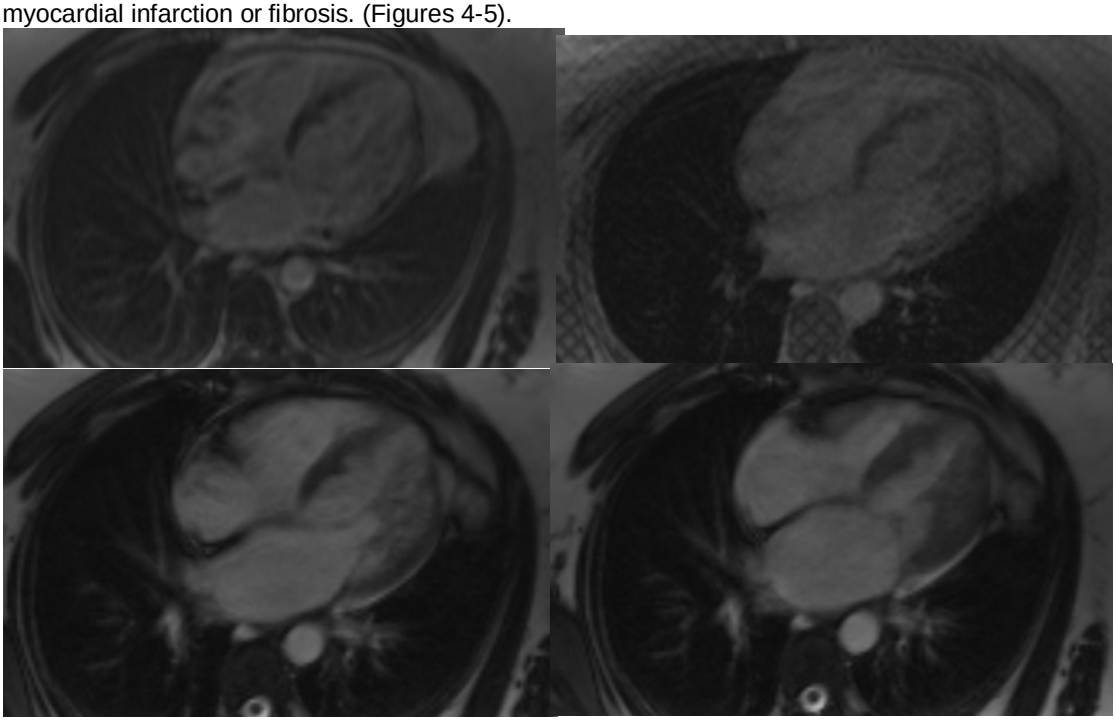

Fig. 4.Four-chamber view of cardiac MRI revealing a LVNC (systole and diastole).

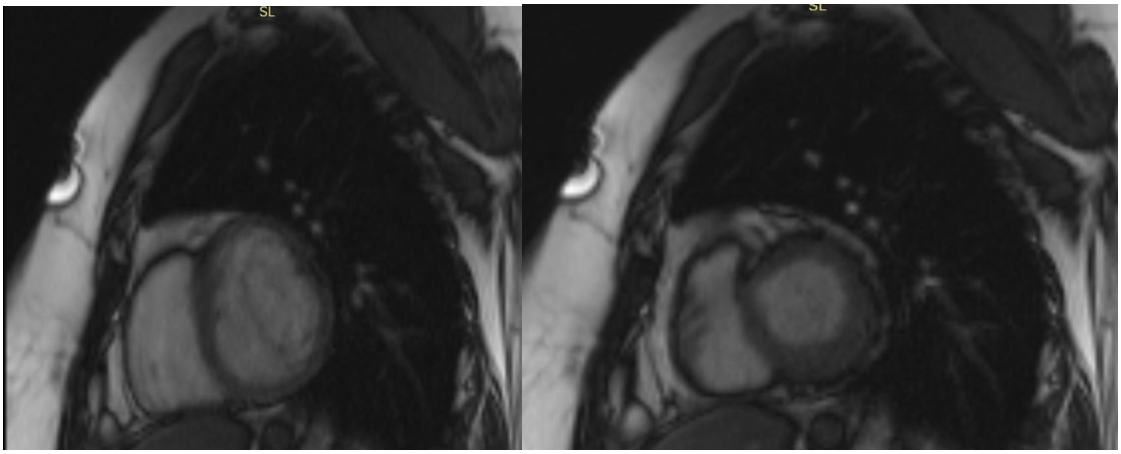

Fig. 5.Short axis view of cardiac MRI revealing a LVNC (diastolic and systolic).

Our patient was started ontreatment of heart failure andacenocoumarol4mg daily as an indefinitely therapy with an international normalized ratio (INR) goal of 2-3. The patient will have regular follow-ups for arrhythmia screening and monitoring of her left ventricular function. The available literature indicates that warfarin will be effective at preventing further embolic events.
Familial screening of first-degree relatives was also negative for LVNC,and congenital heart disease.The patient was, then, put on aspirin, beta blocker, angiotensin-receptor blocker, and anticoagulation therapy with acenocoumarol.
Today, after two years of follow-up under treatment, we noted a good evolution of the symptoms, regression of the episodes of palpitations without any clinical or echocardiographic thrombo-embolic incident.

3. DISCUSSION

NCC is a rare genetic cardiomyopathy [1] first described in 1932 when Bellet et al reported this anomaly in new-borns with aortic atresia and coronary artery-left ventricular fistula. It is characterized by excess of trabeculations in the endocardium, affecting one or both ventricles [2].
LVNCis a rare cardiomyopathy. Prevalence is less than 0.02% and is male predominant [1].It is oftenfamilial with an autosomal dominant mode with defects in genes coding for sarcomere, cytoskeleton, and mitochondrial proteins or sporadic [3].
ECG can be normal, or showing early repolarization abnormalities, QTc prolongation repolarization, atrial fibrillation, paroxysmal supraventricular tachycardia and complete heart block [4].
The most used method of diagnosis is TTE[5]confirmed by the cardiac MRI with a ratio between the end-systolic thickness of the compacted vs noncompacted tissue of greater than 2.0. Recent reports indicate high sensitivity and specificity using a ratio of >2.3 [5].
There are two sets of echocardiographic criteria: the Jenni criteria focused on the presence of a two-layered structure [6], and the Chin criteria focused on the depth of the recess compared with the height of the trabeculations [7]. Jenni criteria are the most accepted validated echocardiographic criteria and consist of evidence of a two-layer structure: a compacted layer and a noncompacted endocardial layer. In the short-axis view, the end-systolic ratio of noncompacted to compacted layers (NC/C) > 2.0 is compatible with the diagnostic [6].Additional criteria that must be met include the absence of any coexisting cardiac abnormalities and colourdoppler evidence of deep perfused intertrabecular recesses [6].Chin criteria [7] considered for diagnosis are the presence of numerous excessively prominent trabeculations and deep intertrabecular recesses with the ratio of the distance from the epicardial surface to the trough of the trabecular recesses and distance from the epicardial surface to the peak of trabeculation ≤ 0.5, assessed at end-diastole on short-axis parasternal views and/or apical views. It is also important that no other cardiac structural abnormalities be present [7].Stollberger *et al.* defined LVNC as trabeculations >/ 3, prominent formations along the left ventricular endocardial border, located apically to the papillary muscles, visible in end-diastole, in one imaging plane, moving synchronously with the compacted myocardium, distinct from the papillary muscles, false tendons, or aberrant bands [8]. Ghebhard *et al.* considered compacted myocardium systolic thickness < 8 mm for diagnosis of LVNC [9].

In difficult cases, other echocardiographic techniques can be used for diagnosis: contrast enhancement, three-dimensional echocardiography, speckle tracking, and tissue doppler imaging. Speckle-tracking echocardiography was used in borderline cases because LVNC affects the left ventricle twist [10].

LVNCis usually associated with cardiac structural abnormalities,reduced ejection fraction or systolic dysfunction, attributed to pathogenic ischemic anddamaged endocardium, as evidenced by fibrotic changes on cardiacMRI and to asynchronism of contraction between the compacted and noncompacted myocardial layers[4].Isolated NCCcan occur as well.

Cardiac MRIplaysa pivot role in diagnosis of LVNC. *Patersen et al* suggest that LVNC is diagnosed accurately with cardiac MRI using the NC/C ratio in diastole. A NC/C ratio of >2.3 in diastole distinguished pathological non-compaction, with values for sensitivity, specificity, and positive and negative predictions of 86%, 99%, 75%, and 99%, respectively [11]**.**For the *Grothoff*criterion, the NC/C ratio is measured in diastolic short-axis views, and the cutoff for LVNC is NC/C ≥3[12].The *Stacey* criterion is calculated from end-systolic short-axis views, with NC/C ≥2 considered positive for an LVNC[13].The Jacquier criterion is estimated from the noncompacted myocardial mass as a percentage of total LV mass; a noncompacted mass ≥20% is considered to indicate an LVNC phenotype[14].

We expose some studies based on TTE andcardiac MRI to define a LVNC (Table 1)[15].

Table 1.Examples of echocardiographic and cardiac MRI approaches to determining the extent of left ventricular trabeculations.

	Jenni et al	Petersen et al	Jacquier et al	Stacey et al	Captur et al
Modality	**TTE**	**MRI**	**MRI**	**MRI**	**MRI**
Sample size	NC* (n = 34) No control group	NC (n = 7) Control subjects (n = 170)	NC (n = 16) Control subjects (n = 48)	NC (n = 122) No control group	NC (n = 30) Control subjects (n = 105)
Study design/ external validation	Retrospective/ no external validation cohort	Retrospective/ no external validation cohort	Retrospective/ no external validation cohort	Retrospective/ no external validation cohort	Retrospective/ no external validation cohort
Definition of NC	Absence of coexisting cardiac disease Numerous excessively prominent trabeculations and deep intertrabecular recesses Intertrabecular spaces filled by direct blood flow from the ventricular cavity, on colour Doppler imaging	Bilayered appearance on TTE combined with increased pretest probability (eg, similar appearance in first-degree relatives, associated neuromuscular disorder, or complications, such as systemic embolization and regional wall motion abnormalities)	Diagnosis of NC was established on echocardiographic criteria	Consecutive patients from MRI reports that mention trabeculation or NC	Diagnosis of NC echocardiographic criteria and at least 1 of the following: positive family history, associated neuromuscular disorder, regional wall motion abnormality, NC-related complications (arrhythmia, heart failure, or thromboembolism)
Description	NC to compaction ratio Decreased thickening and hypokinesia present within, but not limited to the noncompacted segments	Two-layered myocardium measured at the most pronounced trabeculations, avoiding apex measurement perpendicular to compact myocardium	Short-axis cines for total LV** mass and compact mass to define trabecular mass Papillary muscle included in the myocardial mass	Apical short-axis views 16-24 mm from the true apical slice Region with the largest NC to compaction ratio	Loss of base-to-apex fractional dimension gradient

Cardiac phase	End-systole	End-diastole	End-diastole	End-systole	End-diastole
Cardiac view	Short axis	Long axes (4-chamber, 2-chamber, 3-chamber)	Short-axis stack	Apical short axis	Short-axis stack
Excessive trabeculationcutoff	NC to compaction ratio >2	NC to compaction ratio >2.3	Trabecular mass >20%	NC to compaction ratio ≥2	Fractal dimension ≥1.30

* NC = non-compaction, ** LV = left ventricular
These definitions highlight variation in current definitions of excessive trabeculation.

There is no specific therapy for patients with LVNC. Treatment is focused on complications, whichare, heart failure, systemic embolism, and sudden cardiac death [16].Management of symptomatic patient's heart failure isbasedon digoxin, diuretics, angiotensin-converting enzyme inhibitors and beta-blockers. Some patients undergo cardiac transplantation.Cardiac rhythm abnormalities are managed with standard protocol, while some patients may benefit from an implanted cardiac defibrillator for severe ventricular tachyarrhythmias to prevent sudden death[17].
Hypertrabeculation predisposed patients with reduced left the ventricular function are at risk for clot formation. Some literature supports the use of anticoagulation in patients with LVEF≤ 40%), a history of atrial fibrillation, or a prior cardioembolic event. Whether anticoagulants should be administered to every LVNC patient is, however, still debated. Anticoagulation therapy must be targeted to the individual patient after careful assessment of the benefit and risks. Oral anticoagulation therapy (target INR 2.0–3.0) was recommended in patients with impaired systolic function, previous history of embolism, transient ischemic attack, atrial fibrillation, and intracardiac thrombi identified on echocardiogram or another cardiac imaging modality [20].
Otherwise, risk assessment based on $CHADS_2$/$CHADS_2$-VASc scores similar to that used to stratify stroke risk in patients with atrial fibrillationas guidance and preference of the patient is recommended [18],[19]. However, the length of anticoagulation therapy in these patients has not been established. If using warfarin, a targeted INR range of 2-3 has been proposed [9].
Patients with LVNC and sustained ventricular tachycardia or ventricular fibrillation require an implantable cardioverter defibrillator (ICD). These patients are at higher risk for sudden cardiac death, even with normal ejection fraction. This should be based on current implantable cardioverter defibrillator primary and secondary prevention guidelines. Implantable cardioverter defibrillator for primary prevention of sudden cardiac death is indicated for patients with LVNC who present with LVNC and LVEF ≤ 35%.Patients with malignant ventricular tachyarrhythmia should receive implantable cardioverter defibrillator for secondary prevention [20].
The outcomes of transplanted patients have yet to be established.
Follow-up consists of symptom assessment, LVEF monitoring, and arrhythmia screenings, including electrophysiology evaluation if needed[9],[20].
All patients should receive family and genetic counselling[9].

4. CONCLUSION

LVNC is an uncommon cause of cardiomyopathy. A gold standard for diagnostic criteria has not been established. Further research and collaboration from major organizations are necessary to create a standardized criteria for the diagnosis and management of this pathology. The management and treatment of each case of LVNC should be individualised to each patient.All patients should receive family and genetic counselling.
2D-echocardiography and cardiac MRI play a pivotal role in the diagnosis and management of LVNC. However, more studies are needed to establish the choice and duration of anticoagulants, includingdirect oral anticoagulant.

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