

CASE PRESENTATION

Midterm follow-up in a patient with left ventricular noncompaction cardiomyopathy and CRT-D

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Abstract: **Introduction** – Left ventricular noncompaction (LVNC) is a rare cardiomyopathy characterized by excessive trabeculation in the myocardium. Management of LVNC includes treatment for heart failure, arrhythmias, and thromboembolic events. **Case report** – A 59 years old patient was admitted for syncope and episodes of nonsustained ventricular tachycardia (VT). The ECG showed atrial fibrillation and left bundle branch block. Transthoracic echocardiography revealed particular aspect of excessive trabeculation, low ejection fraction, severe global hypokinesia, intra and interventricular asynchronism. Excessive trabeculation of left ventricle was evaluated using contrast echocardiography. A biventricular defibrillator implant was performed. Obvious left ventricular function and NYHA class improvement occurred short time after implantation. During the follow-up the patient experienced sustained VT converted by internal electric shock. Few data are known about CRT-D indications and follow-up in patients with LVNC. Our case report supports defibrillator implant for primary prevention of sudden cardiac death and shows a favorable outcome of CRT in patients with LVNC.

Keywords: left ventricular noncompaction cardiomyopathy, heart failure, cardiac resynchronization therapy, implantable cardioverter defibrillator.

Rezumat: **Introducere** – Cardiomiopatia prin noncompactare de ventricul stâng (CNCVS) este caracterizată prin prezența de miocard intens trabeculat, cu recese și travee adânci. Managementul include tratamentul insuficienței cardiace (IC), al aritmiilor și al evenimentelor tromboembolice. **Prezentare de caz** – Pacient, 59 de ani, internat pentru sincopă și episoade de tahicardie ventriculară (TV) nesuținută. ECG - fibrilație atrială, bloc major de ramură stângă. Ecografia transtoracică – trabeculații excesive la nivelul ventriculului stâng (VS), fracție de ejeecție redusă, hipokinezie globală severă, parametrii de asincronism intra și interventricular prezenți; trabecularea excesivă a VS a fost reevaluată utilizând ecocardiografie cu substanță de contrast. S-a realizat implant de defibrilator cardiac biventricular, cu evoluție favorabilă: îmbunătățirea evidentă a contractilității VS și ameliorarea simptomelor de IC. În decursul perioadei de urmărire pacientul a prezentat un episod de TV susținută convertit prin șoc electric intern. Există puține date privind indicațiile de implant de defibrilator cardiac și terapie de resincronizare (CRT-D), precum și urmărirea pe termen mediu și lung a pacienților cu CNCVS. Prezentarea noastră este în favoarea CRT-D în prevenția primară a morții subite cardiace pentru pacienții cu CNCVS și demonstrează un răspuns favorabil la terapia de resincronizare cardiacă.

Cuvinte cheie: cardiomiopatie prin noncompactare de ventricul stâng, tahicardie ventriculară, terapie de resincronizare cardiacă, defibrilator implantabil.

INTRODUCTION

Left ventricular noncompaction (LVNC) is a rare congenital disorder which affects the normal compaction process of the myocardium during fetal development and it is characterized by prominent ventricular trabeculations and deep intertrabecular recesses on the luminal surface of the left ventricle¹. The etiology and pathogenesis of LVNC is still a debate, the *European Society of Cardiology* (ESC) considers LVNC as an “unclassified cardiomyopathy” because LVNC can appear as a morphological trait of diverse cardiomyopathies,

while the *American Heart Association* refers to LVNC as distinct primary genetic cardiomyopathy. Identification of mutations in the genes that encode the sarcomeric, cytoskeletal, and nuclear membrane proteins advocates for a genetic cause².

The clinical presentation ranges from asymptomatic forms to patients who develop heart failure, thromboembolism, ventricular arrhythmias and sudden cardiac death. Echocardiography is a conventional diagnosis tool, but sometimes confirmation of diagnosis requires other techniques, including contrast ventriculogra-

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phy, CT and MRI. Widely accepted echocardiographic diagnostic criteria by Chin focus on the depth of the recesses compared with the height of the trabecula, while Jenni et al. underline the importance of the presence of a two-layered structure^{3,4}. Differential diagnosis includes arrhythmogenic right-ventricular cardiomyopathy, hypertrophic or dilated cardiomyopathy, endocardial fibroelastosis and different other cardiomyopathies that can resemble with trabecular myocardium⁴.

In conclusion, symptoms, diagnosis, and prognosis are variable because of the heterogeneous nature of this disease, making treatment often empirical and mimicking the treatment of other cardiomyopathies. However, there are management issues that should be addressed in each patient with LVNC, including genetic testing and family screening, the need for implantable cardioverter defibrillator placement, the role of anticoagulation in prevention of thromboembolic complications, and prescriptions/restrictions for implementation of physical activity⁵.

CASE REPORT

We report the case of a 59 years old male, admitted in our clinic with syncope and heart failure (HF) symptoms functional class NYHA III and paroxysmal nocturnal episodes of intense dyspnea. Physical examina-

tion revealed low blood pressure (90/60 mmHg), irregular heart beats, moist crackles halfway up bilaterally, lower extremity pitting edema. The blood tests found electrolyte imbalance with mild hyperkalemia and moderate chronic renal disease (creatinine clearance 51 ml/min).

The ECG (Figure 1) showed atrial fibrillation with rapid ventricular response and complete left bundle branch block. The patient had an ECG Holter monitoring (before admission) showing unsustained episodes of ventricular tachycardia (VT). We repeated during hospitalization another ECG Holter monitoring, under proper treatment with amiodarone and betablocker, which also showed episodes of unsustained VT.

Transthoracic echocardiography revealed left ventricle dilatation with left ventricular end diastolic diameter 7 cm, ejection fraction (Figure 3b, 3c) 20% - average of 6 measurements (range 18 – 25%); moderate functional mitral regurgitation and severe left atrium dilatation – 253 ml (Figure 3). The left ventricle was global hypokinetic with inter and intraventricular dyssynchronism (Figure 4a, 4b, 4c). Interventricular dyssynchrony was defined as >40 ms difference between left ventricular and right ventricular pre-ejection time, measured by pulsed-wave Doppler⁶. More than 65 ms delay between the contraction of two different segments of LV shows intraventricular dyssynchronism and represent a good predictor to CRT⁷. Septal flash was assessed in apical 4 chamber view (Figure 5). Speckle tracking echography showed LV lateral wall dyskinesia (Figure 6). In apical 4 chamber view a particular aspect was noticed with prominent trabeculations at the apex and 1/3 apical on the lateral wall of LV (Figure 7). We performed contrast echocardiography that revealed prominent trabeculations and deep intratrebecular recesses perfused by contrast at the apex, 1/3 apical

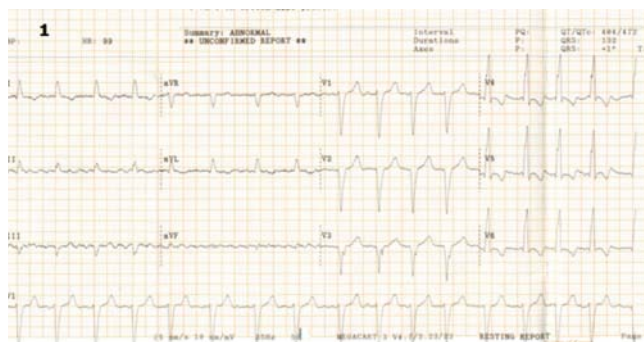


Figure 1. ECG performed at admission: atrial fibrillation with rapid ventricular response 99 b/min; complete left bundle branch block, QRS = 132 ms, no R in DI, aVL, V5-V6.

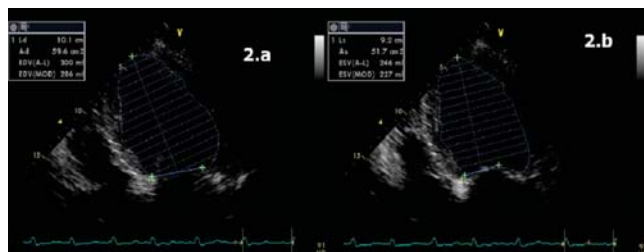


Figure 2. Apical 4 chamber view. The EF was calculated as a average of several measurements. Figure 2.a. LVEDV = 300 ml. Figure 2.b. LVESV = 246 ml. Calculated EF = 18%.

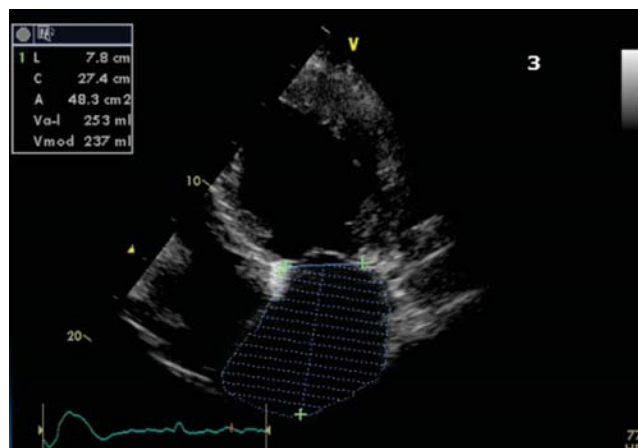


Figure 3. Apical 4 chamber view showing severe left atrium dilatation.

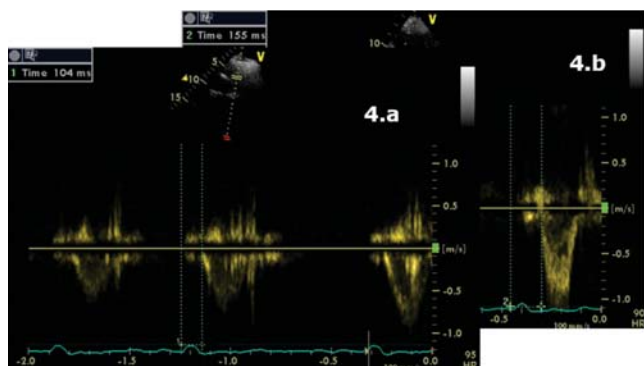


Figure 4.a Parasternal short axis view, pulsed-wave Doppler. Pulmonary preejection time = 104 ms. 4.b Apical 5 chamber view, pulsed-wave Doppler. Aortic pre-ejection time 155 ms. Inter ventricular dyssynchrony = 51 ms.

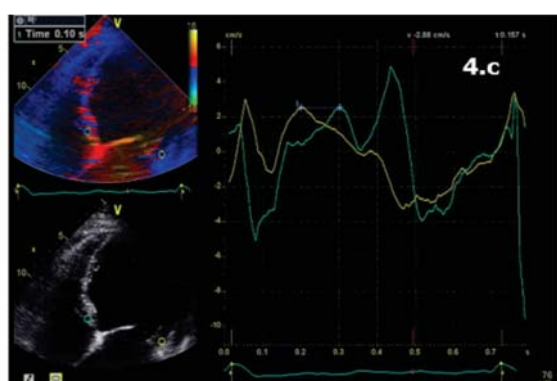


Figure 4.c Apical 4 chamber view. TDI pulsatility offline. 100 ms difference between septal wall (blue) and lateral wall (yellow) = intraventricular dyssynchrony.

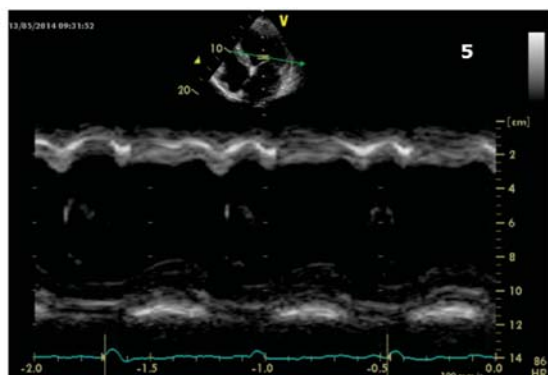


Figure 5. Apical 4 chamber view. M Mode through lateral and septal wall showing septal flash.

of lateral wall, and inferior wall of LV (Figure 8a.b.c), fulfilling Chin and Jenni criteria for LVNC.

Coronary angiogram excluded significant coronary artery disease.

Using direct puncture left subclavian vein approach we performed biventricular defibrillator implantation using two leads: I. right ventricle (2 coil defibrillator lead) and II. left ventricular bipolar lead placed in a posterolateral branch of coronary sinus (Figure 9a.b).

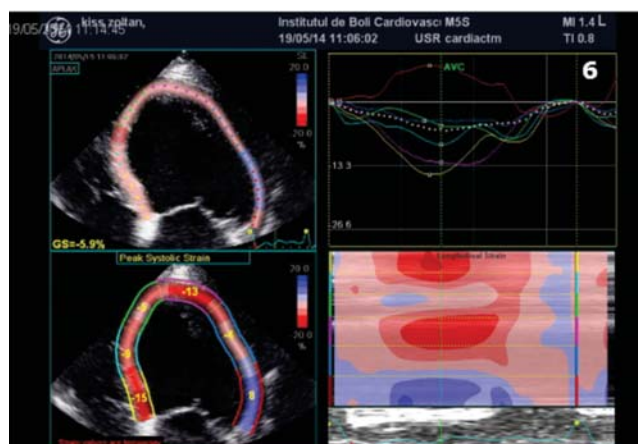


Figure 6. Speckle tracking echocardiography. Longitudinal strain rate showing lateral wall dyskinesia (blue).

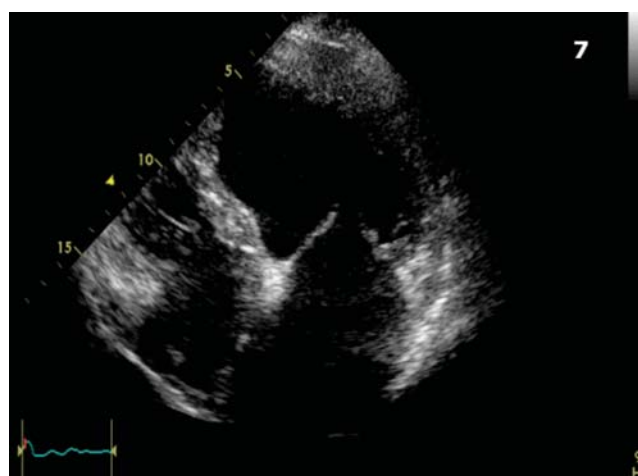


Figure 7. Apical 4 chamber view. Particular aspect showing prominent trabeculations at the apex and 1/3 apical on the lateral wall of LV.

The defibrillator was programed as follows: VVIR 80 b/min, VV interval 25 ms (after optimization both ECG and echocardiography); 2 zone configuration for VT detection: first at 176 b/min (340 ms); and ventricular fibrillation (VF) from 200 b/min (300 ms). Post procedural outcome was favorable, without any complications. In-hospital treatment with furosemide 2*40 mg (i.v initially), amiodarone 200 mg, carvedilol 2*12,5 mg, candesartan 16 mg, rosuvastatinum 10 mg, acenocumarolum 4 mg was continued after discharge. Heart rate management was easily obtained using only beta-blocker/amiodarone and complete biventricular capture close to 100% was achieved at discharge.

During 1 year follow up period the patient needed multiple treatment readjustments (follow-ups each 3 months), with decreasing doses of diuretic and progressive increase of antihypertensive medication as the patient had multiple episodes of high blood pressure (the highest value 180/110 mmHg).



Figure 8. Contrast echocardiography. a. Apical 4 chamber view. Prominent trabeculations at the apex and 1/3 apical on the lateral wall of LV with deep intratrabecular recesses perfused by contrast. b. Apical 2 chamber view, oblique incidence. Prominent trabeculations and deep intratrabecular recesses perfused by contrast on the inferior wall. c. Apical 4 chamber view. L2/L1 = 0.41 (<0.5, positive Chin criteria).

At 1 year follow up the patient was hospitalized, although in NYHA functional class II, for evaluation after an episode of palpitations without syncope, but with internal electrical shock deliver.

The ECG showed biventricular stimulation without spontaneous QRS complexes (Figure 10). The echocardiography confirmed the maintenance of improved ventricular contraction (Figure 11), EF = 35% (Figure 12), mild mitral regurgitation. The ICD interrogation showed biventricular pacing 97%, 1 episode of VT 218 b/min, rapidly detected in VF zone, converted to sinus rhythm by internal electrical shock 36J (therefore no syncope occurred: good tolerance of high ventricular rate which confirms the improvement of clinical status).

To provide biventricular pacing as closed to 100%, several modulation rate parameters were changed, such as activity sensor threshold, slope and reaction time to achieve a more physiological pacing behaviour, without loss of capture during physical activity (several exercise test were performed to check capture).

DISCUSSIONS

The largest series to date for adults with LVNC are small but include the most information on the natural history of disease. The current recommendations for treatment follow the international guidelines of

heart failure management. Treatment usually requires the combination of beta-blockers, ACE inhibitors/ARB, diuretics and aldosterone antagonists⁸. Oral anticoagulation is generally recommended to those presenting ventricular systolic dysfunction, antecedent of systemic embolism, presence of cardiac thrombus and atrial fibrillation⁹.

ICD are frequently used for primary and secondary prevention in LVNC, but follow up data about are insufficient. A study published in 2011 evaluated indications and follow up in patients with LVNC and ICD implant both in primary and secondary prevention. Frequent appropriate ICD therapy was observed in both groups, supporting the application of current ICD guidelines for primary and secondary prevention of sudden cardiac death in LVNC¹⁰.

Although ICD implant is a treatment option, its superiority over medical treatment is still a debate. There are highly arrhythmogenic LVNC patient case review in the literature in which the authors preferred antiarrhythmic treatment, without need of an ICD^{11,12}.

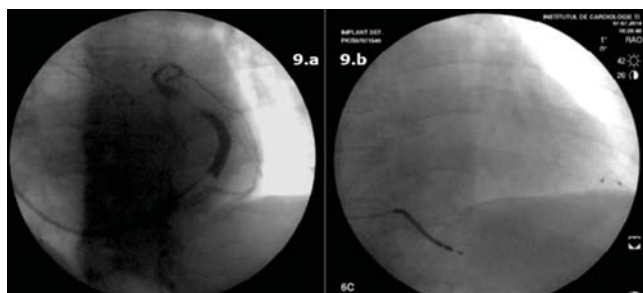


Figure 9. Fluoroscopy images. a. Sinusography in left anterior oblique view. b. Antero-posterior view showing the right ventricle defibrillator lead and the left ventricle lead placed in a posterolateral branch of the coronary sinus.

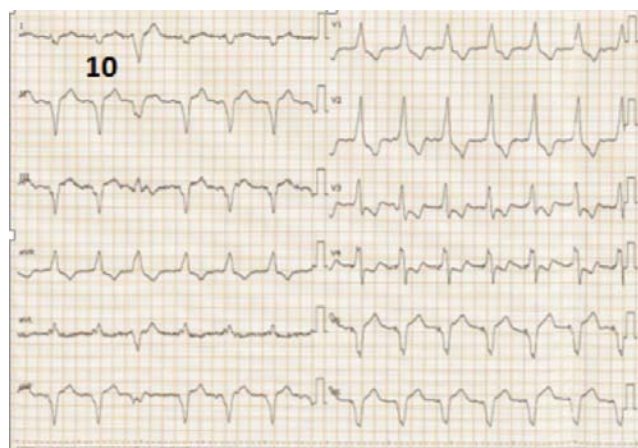


Figure 10. ECG at 1 year follow up showing atrial fibrillation, biventricular rhythm with R wave in V1, and negative QRS complex in D1, V5, V6.

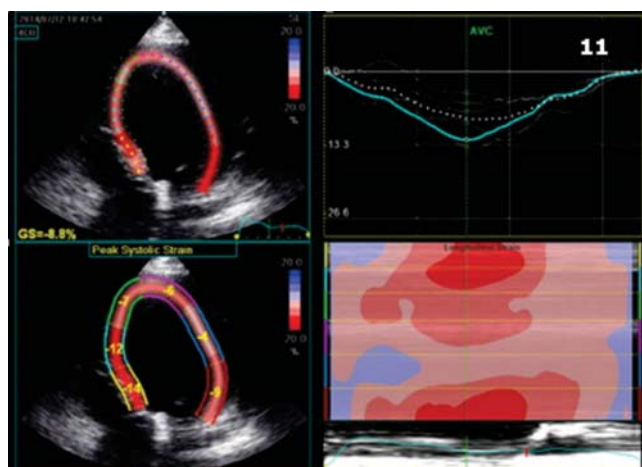


Figure 11. Speckle tracking echography. Longitudinal strain rate showing improved contraction of LV lateral wall.



Figure 12. Apical 4 chamber view. Calculated EF = 35%.

Galizio et al. proposed a number of criteria for identifying patients with LVNC at risk of sudden cardiac death (SCD). A low ejection fraction EF <30%, and more than 2 risk factors (family history of sudden death, syncope and nonsustained VT) were considered criteria for increased risk of SCD and ICD implant. This pattern of risk stratification of sudden death and the choice of patients who would be benefited most with the implantation of an ICD seems relevant, due to the observation of absence of sudden death in the group without ICD and the presence of appropriate (VT/VF) shocks in ICD group¹³.

CRT improves morbidity and mortality in patients with desynchronized HF, but CRT response remains variable, and one of the determinants is HF etiology. Studies about CRT in LVNC patients are rare and incomplete, and it is not yet clear if these patients would benefit from CRT. Qiu et al. demonstrated that CRT improves heart function, morphology and mechanical dyssynchrony in LVNC patient¹⁴. He evaluated left ventricular remodeling and mechanical synchronicity before and after CRT in LVNC patients by comparing with idiopathic dilated cardiomyopathy (DCM) patients; he showed that compared with DCM group, there was no significant difference in LV response rate, improvement of LV function and dyssynchrony index. Furthermore, Penela et al. showed that mechanical dyssynchrony, amenable to correction with CRT, is common in patients with LVNC, independently from QRS width¹⁵.

In conclusion, our presentation reports a case of LVNC cardiomyopathy diagnosed with ecocardiographic tools; associated HF with low EF and 1 syncopal episode with nonsustained VT on Holter ECG monitoring made reasonable CRT-D therapy. Appropriate use

of the defibrillator and improving in LV contraction supports primary prevention ICD implant and CRT in patients with LVNC.

Conflict of interest: none declared.

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