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Синдром некомпактного міокарда лівого шлуночка

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Вступ. Синдром некомпактного міокарда лівого шлуночка (СНКМ ЛШ) – рідкісна кардіоміопатія, зумовлена вродженим дефектом процесу ембріогенезу шлуночків. Головною ознакою цієї патології є виражені трабекули у лівому шлуночку серця і глибокі міжтрабекулярні затоки. Патологічна структура міокарда призводить до його дилятації і дисфункції, симптомів серцевої недостатності, емболічних епізодів та аритмій.

Мета роботи – представити спектр клінічних проявів при СНКМ ЛШ.

Матеріали і методи. Діагностику і лікування пацієнтів із СНКМ ЛШ виконували у Львівському обласному кардіологічному центрі. Двоє пацієнтів мали симптоми серцевої недостатності, один з них – блокаду лівої ніжки пучка Гіса (БЛНПГ) і серцеві аритмії, один з пацієнтів - неспецифічні болі в грудній клітці. Візуалізацію серця виконали за допомогою ехокардіографії у всіх пацієнтів, МРТ серця - у двох пацієнтів.

Результати. Ознаки СНКМ ЛШ виявили при ехокардіографії у всіх пацієнтів, у двох підтвердили за допомогою МРТ серця. Пацієнтів із симптомами серцевої недостатності лікували з використанням оптимальної медикаментозної терапії, у пацієнта з БЛНПГ імплантували ресинхронізуючий пристрій (CRT-D). Безсимптомний пацієнт перебуває під наглядом.

Висновки. СНКМ ЛШ - кардіоміопатія з характерними ехокардіографічними і МРТ-ознаками та широким спектром клінічної маніфестації. Прогноз при СНКМ ЛШ серйозний відповідно до систолічної дисфункції ЛШ, серцевих аритмій, емболічних подій. Діагностичним інструментом виявлення СНКМ ЛШ є ехокардіографія, МРТ серця підтверджує діагноз у випадках, коли ехокардіографічні дані є недостатніми.

Ключові слова: МРТ серця, компактність, ехокардіографія, камери серця, шари міокарда, некомпактна кардіоміопатія, систолічна дисфункція.

Introduction. Left ventricular non-compaction (LVNC) is a rare form of congenital cardiomyopathy due to a defect of the intrauterine process of ventricular embryogenesis [4]. The main feature of this pathology is the existence of prominent trabeculations and deep intertrabecular recesses in the left ventricle [LV]. The abnormal structure of the myocardium leads to its dilatation and dysfunction, heart failure symptoms, embolic episodes and arrhythmia. Cardiac imaging provides clues to the diagnosis. Serious prognosis in patients with LVNC prompts us to share information about it's clinical and echocardiographic features among cardiologists and the medical community to increase awareness of this pathology. We present a series of cases of LVNC, illustrated with images from echocardiography and cardiac MRI.

Engberding and Bender in 1984 were the first to describe the specific echocardiographic features in a 33 years old female patient with heart failure [5]. Next, Jenni et al reported a 21-years old patient with heart chambers dilatation and

systolic dysfunction. Echocardiography revealed hypertrabeculation and deep intertrabecular recesses in both ventricles. The authors described them as "persisting myocardial sinusoids" [12]. Chin et al was the first to propose the term "isolated noncompaction of left ventricular myocardium" assuming that the disease is due to an arrest of the normal myocardial compaction during embryogenesis. The first report of a 10-year experience with a group of 17 patients with LVNC was published by Ritter et al in 1997 in which they revealed the high incidence of heart failure, systemic embolism, arrhythmic disorders, higher mortality and frequent need in heart transplantation [21].

The number of publications concerning the genetic background, diagnostics and treatment of patients with LVNC have increased progressively [3, 9, 13, 14, 15, 17, 19]. The number of patients reported by Oechslin (20002) was 34 and by Habib (2011) was 105. The initial assumption about definitely negative prognosis changed with increasing recognition of this pathology in earlier stages. However, the diagnosis of LVNC remains unfamiliar to a majority of physicians. Uncertainty exists in diagnostic criteria to differentiate this pathology from physiological trabeculations and different pathological conditions (such as hypertrophic cardiomyopathy) [10, 22, 23].

Pathogenesis. The left ventricular myocardium appears as a loose network of myofibrilla, and the process of its compaction begins at the 5-8th week period of embryogenesis [11]. This process begins from pericardium to endocardium and from basal segments to apex. In patients with LVNC the arrest of the compaction process occurs in embryogenesis. The inner layer of myocardium remains trabecular. The deep recesses between trabeculae are supplied with blood from the LV cavity. Among the different gene mutations that have been identified in patients with LVNC are: taffazzin - G 4.5 gene, alpha-dystrobrevin gene, lamin A/C, alpha-cardiac actin; the sarcomere gene mutations were the most frequent [11, 25, 27]. The exact frequency of LVNC remains unknown, because of uncertainty of diagnostic criteria, but multiple authors report, that this diagnosis is made in 0,014% - 0,26% of patients, who underwent echocardiographic examination [9, 13, 23].

Clinical manifestation. The pathological LV structure leads to dilatation and dysfunction of the myocardium, and to heart failure symptoms, which remain the most frequent symptoms in patients with LVNC [9, 13, 14, 15, 17]. Deep intertrabecular recesses create conditions for intracardiac thrombi formation, especially in patients with low myocardial contractility [11, 14, 15, 24]. A number of publications report embolic episodes in patients with LVNC with different location of the emboli, the most frequent being cerebral [8, 9, 17]. Myocardial infarction due to embolic origin in patients with LVNC is reported with increasing frequency [9]. Myocardial heterogeneity in LVNC together with systolic dysfunction and fibrosis causes the wide spectrum of cardiac arrhythmia, which could be life threatening. The authors report the incidence of ventricular arrhythmia from 7% to 41% in patients with LNVC [9, 14, 17]. So ECG holter monitoring is indicated in LVNC syndrome. Preventive ICD implantation is indicated in patients with LVNC and documented sustained ventricular tachycardia or ventricular fibrillation [11]. An increasing number of ICD implantation is reported in patients with LVNC to prevent sudden cardiac death [9, 14, 17]. Electrocardiographic features of LVNC include frequently left bundle branch block in adult and Wolf-Parkinson-White syndrome in children [3, 9, 14, 17, 19]. Asymptomatic patients with echocardiograpchic features of LVNC are reported with increasing frequency [9, 17]. Prognosis in this asymptomatic cohort seems to be much better, than in symptomatic patients [9].

Echocardiography was the first method of cardiac imaging which allowed identifying the LVNC syndrome [3, 5, 13]. Characteristic echocardiographic appearance of LVNC is detection of a two-layer myocardial structure in the mid-ventricular and apical levels of the LV with a thick inner non-compacted layer and a thin compacted layer, non-compacted layer consists of trabeculae with deep intertrabecular recesses, which are supplied with blood directly from the LV cavity (Fig. 1 - 6) [13]. Although the first description of echocardiographic features of LVNC was made in 1984, the clear diagnostic criteria still remain challenging [5]. Three sets of diagnostic criteria were proposed. The first of them, the "California criteria" by Chin defined LVNC "…as the ratio (x-to-y) of the distance from the

epicardial surface to the trough of a trabecular recess (x) and the distance from the epicardial surface to the peak of the trabeculation (y) at enddiastole ≤ 0.5" [3]." The second set of criteria, proposed by Stollberger (Vienna criteria) proposes four or more trabeculations, protruding into the LV cavity, visible in one imaging plane [23]. The set of criteria by Jenni et al (Zurich criteria) has the most distinct criteria and includes [13]:

- two-layer structure of LV myocardium, with a thin compacted and thicknon-compacted layers,
- systolic non-compacted to compacted ratio >2 (in parasternal short-axis view at mid-ventricular level), (Figs. 3 ,5)
- color Doppler evidence of blood supplementation to the intertrabecular recesses from the LV cavity, (Fig. 6), and
- absence of associated heart disease.

Echocardiographic assessment can lead both to underestimation and to overestimation of LVNC syndrome [22]. The latter occurs if numerous left ventricular trabeculations close to the apex, which do not meet the criteria but are considered as LVNC symptoms. Underestimation of LVNC occurs when the regions of the mid-ventricular and apical segments are not properly visible during echocardiography. Cardiac MRI provides an opportunity to identify LVNC more precisely because of its excellent resolution at any plane of imaging [1, 2, 6, 7, 16]. MRI-criteria of LVNC (ratio of non-compacted to compacted ration >2.3) as proposed by Peterson in 2005 allows to distinguishe "pathological non-compaction, with values for sensitivity, specificity, positive and negative predictions of 86%, 99%, 75%, and 99%, respectively" [20]. Cardiac MRI is a method of confirming LVNC diagnosis in patients, when echocardiographic criteria remain doubtful, and allows identifying cardiac fibrosis in patients with LVNC during late gadolinium enhancement (Figs. 1, 2) [16, 26]. Nucifora et al found, that the presence and extent of myocardial fibrosis along withLV dysfunction are related to adverse clinical events [16].

Treatment depends on the clinical manifestation, and concerns management of heart failure symptoms, cardiac arrhythmia and thromboembolic complications [9, 11]. Beta-blockers and angiotensin-converting enzyme (ACE) inhibitors are (CRT) is indicated for the patients with LV dilatation, systolic dysfunction with low ejection fraction and left bundle branch block. Antiarrhythmic medications (amiodarone) are recommended for patients with potentially lethal arrhythmias, and ICD implantation is indicated for sudden cardiac death prevention. Anticoagulation with vitamin K antagonists or new oral anticoagulants is recommended in patients with low ejection fraction (<40%), thromboembolic episodes or atrial fibrillation. Patients with low ejection fraction and ineffective optimal medical therapy are candidates for heart transplantation [9, 14, 17].

Thus, the aim of the manuscript is to present a spectrum of clinical manifestations of left ventricular non-compaction (LVNC).

Materials and methods. We present a series of cases of LVNC, illustrated with images from echocardiography and cardiac MRI. We used echocardiographic equipment Sonline Versa Plus (Siemens) and Philips HD 11 XE with transducer 3,5 MHz. Cardiac MRI studies were performed using a 1.5-Tesla scanner (Excelart Vantage ZGV Atlas) with ECG gating. For the echocardiographic diagnosis of LVNC we used criteria proposed by Jenni et al [13], for MRI – criteria, proposed by Peterson [20]. We evaluated 17 segments of the LV and found that different number of segments was involved in patients, midwall and apical segments of inferior, posterior and lateral wall were involved in noncompaction in all patients.

Results

Clinical case 1. A 24 year old male was admitted to The Lviv Regional Centre of Cardiology with shortness of breath during physical exertion. He denied any viral or respiratory infection before the onset of symptoms. He denied any drug or alcohol abuse. Echocardiography revealed an extremely low ejection fraction of 20%, dilatation of the left heart chambers (LV 6.5 cm) and functional mitral regurgitation. Echocardiographic features of LV non-compaction were revealed in the middle and apical segments of the LV: two-layer structure of the myocardium with a thick inner layer, with trabeculae and a thin external compacted layer. The diagnosis was confirmed with cardiac MRI (Figs. 1, 2) The patient was treated with ACE-inhibitors, spironolacton, beta-blockers (Carvedilol), all doses were titrated.

Anticoagulation was initiated with enoxaparin and continued with warfarin. ECG Holter monitoring did not reveal arrhythmic disorders. Clinical status of the patient improved gradually. However, ejection fraction remained low (20%). The patient is considered as a candidate for the heart transplantation.

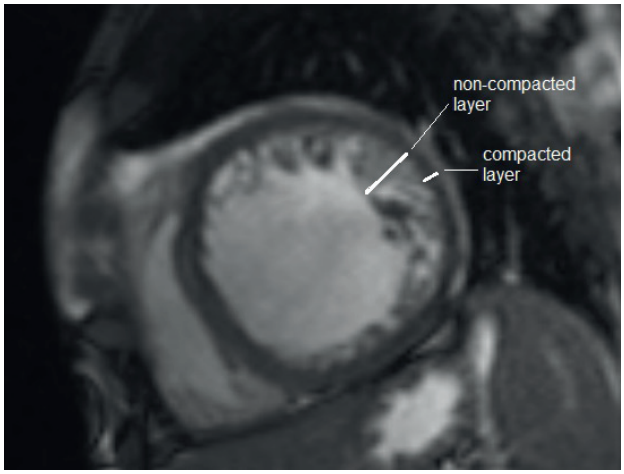

Fig.1. Patient 24 y.o. Cardiac MRI. Short axis view.

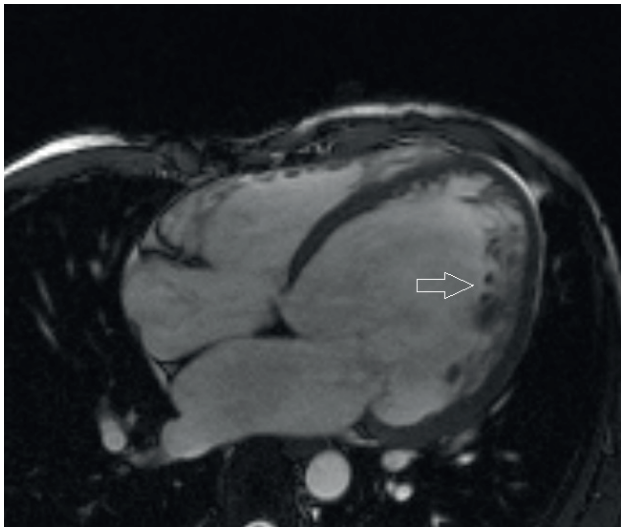

Fig. 2. Patient 24 y.o. 4-chamber view. Arrow – non-compacted layer.

Clinical case 2. A 32-year old patient was admitted to the cardiological department with complaints of the shortness of breath, fatigue, and dysrhythmias. Size of the heart was enlarged, and on ECG left bundle branch block with wide QRS (180 ms) was revealed. Echocardiography revealed left ventricular dilatation, systolic dysfunction with EF 30%, moderate functional mitral regurgitation, and criteria of LVNC (Figs. 3, 4). Holter ECG monitoring documented episodes of atrial fibrillation. Patient started with heart failure therapy, anticoagulation and amiodarone. However, heart failure symptoms of NYHA III class were still present. Taking into consideration left bundle branch block with wide QRS complexes, implantation of CRT was recommended together with ICD. After CRT-D system was implanted, shortening of QRS complexes was achieved (120 ms). The patient's clinical status improved, his EF increased to 38%, and he was in NYHA class II. During follow-up period there were proper discharges of ICD that confirmed the necessity of ICD implantation together with CRT. Follow-up period after CRT-D implantation is 6 years.

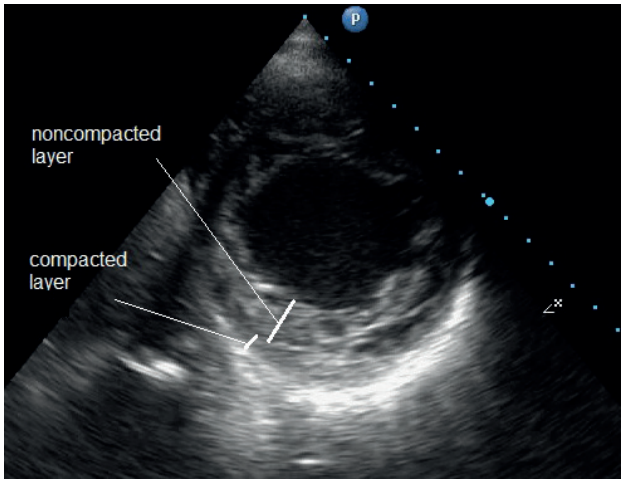

Fig. 3. Patient 32 y.o. Echocardiography. Short axis view. Ratio of non-compacted to compacted layers 2,6:1.

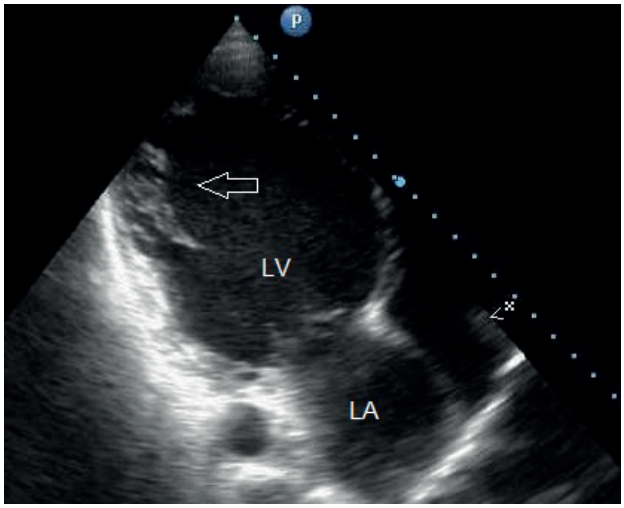

Fig. 4. Patient 32 y.o. Echocardiography, modified 4-chamber view. Arrow – non-compacted layer of lateral LV wall.

Clinical case 3. An 18 y.o. patient underwent echocardiographic examination due to unspecific chest pain (cardialgia). Echocardiography revealed normal heart chambers dimensions, normal systolic function with EF 65%, mild mitral valve prolapse, and two-layer structure of mid-ventricular and apical LV myocardium, with evidence of LV non-compaction. Stress-test and ECG Holter monitoring didn't reveal any changes. Patient had regular follow-up during 5 years without LV dilatation or dysfunction.

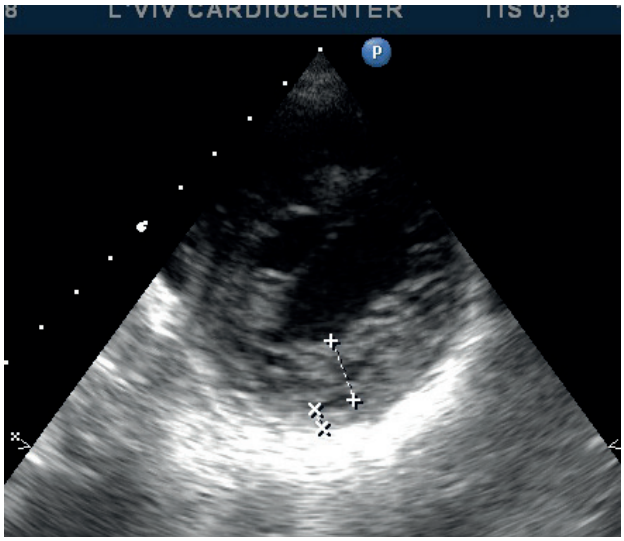

Fig. 5. Patient 18 y.o. Echocardiography. Short axis view. Ratio of non-compacted to compacted layers 2,5:1.

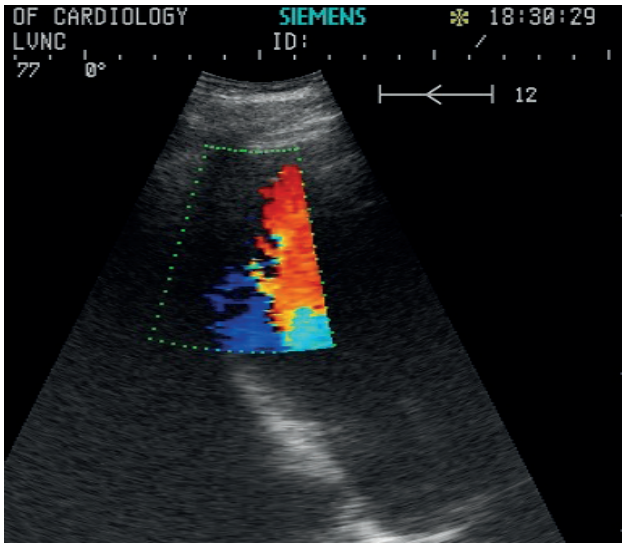

Fig. 6. Echocardiography, 4-chamber view, color Doppler. Evidence of blood supply of intertrabelular recesses from LV cavity.

Conclusions. Left ventricular non-compaction is an unclassified cardiomyopathy with distinct echocardiographic and MRI-features and wide spectrum of clinical presentations. The prognosis in case of LVNC is serious due to systolic LV dysfunction, cardiac arrhythmia and embolic events. Echocardiography is a diagnostic tool to identify LVNC, cardiac MRI confirms the diagnosis of LVNC if echocardiography data is insufficient and allows to evaluate cardiac fibrosis.

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