Imaging techniques in diagnosis and management of patients with diabetes

Técnicas de imagen en el diagnóstico y manejo del paciente diabético

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Abstract
Diabetes mellitus is one of the diseases with higher impact in the Spanish community and health care system as a consequence of its high prevalence and their associated direct and indirect costs. The prevalence of diabetes in patients with coronary disease in Spain is approximately of 20%. Both physiopathology and clinical manifestation are dependent on the location of vascular abnormalities. In patients with type 2 diabetes, the development and progression of the atheroma plaque are not only more rapid but it seems that prevailing mechanisms are different than in non-diabetic patients. Therefore, cardiac imaging techniques may play a key role to detect asymptomatic patients with high atherothrombotic risk. Currently, echocardiography is the gold-standard technique for the initial evaluation of the symptomatic patient or with suspected cardiac dysfunction. Echocardiographic evaluation of systolic and diastolic ventricular function both at rest and under stress provides important diagnostic and prognostic information for the management of the diabetic patients. However, despite its potential usefulness, the criterion to select the diabetic patients who might benefit from a non invasive screening of coronary disease is still controversial and prospective studies are necessary to determine which imaging techniques are more useful in diabetic patients.

Keywords: diabetes mellitus, cardiovascular disease, diabetic cardiomyopathy, echocardiography, diabetic heart disease, systolic dysfunction, diastolic dysfunction.

Resumen
La diabetes mellitus es una de las enfermedades con mayor impacto en la población española y en el sistema sanitario, como consecuencia de su elevada prevalencia y de los costes directos e indirectos que genera. La prevalencia de diabetes en pacientes con cardiopatía isquémica en España es aproximadamente del 20%. La fisiopatología y la repercusión clínica varían en función del lecho vascular afectado. En pacientes con diabetes tipo 2, el desarrollo de la placa de ateroma no sólo es más rápido, sino que los mecanismos responsables parecen diferir respecto a los de los pacientes no diabéticos. En este escenario, las técnicas de imagen cardiaca adquieren un papel importante para detectar a los pacientes asintomáticos con riesgo aterotrombótico alto. La ecocardiografía es actualmente la técnica de elección en la valoración inicial del paciente con síntomas o sospecha de disfunción cardiaca. La valoración mediante ecocardiografía de la función sistólica y diastólica, basal y tras un esfuerzo, aporta información diagnóstica y pronóstica para el manejo de los pacientes diabéticos. Sin embargo, a pesar de su potencial utilidad, el criterio para seleccionar a los pacientes diabéticos que podrían beneficiarse de un cribado no invasivo de enfermedad coronaria es todavía muy controvertido, y se requieren estudios prospectivos para determinar cuáles son las pruebas de imagen cardiaca más útiles en estos pacientes.

Palabras clave: diabetes mellitus, enfermedad cardiovascular, miocardio diabética, ecocardiografía, enfermedad cardiaca diabética, disfunción sistólica, disfunción diastólica.

List of acronyms quoted in the text:
DM: diabetes mellitus; CD: coronary disease; ECG: electrocardiogram; CVD: cardiovascular disease; ECHO: echocardiogram; LVEF: left ventricular ejection fraction; AH: arterial hypertension; LVH: left ventricular hypertrophy; LVCI: left ventricular contractility index; MDCT: multidetector computed tomography; LVM: left ventricular mass; TDV: telediastolic volume; LVTDV: left ventricular telediastolic volume.
Introduction

The diabetes mellitus (DM) is one of the diseases with higher socio-economical impact in the Spanish population. The frequency of chronic complications and high mortality generated suppose an expense of more than 6% of the total health care budget. The T2D supposes 90% of all the diabetes forms and more than 80% of these patients suffer cardiovascular impairments in which the predominating damage is the atherothrombotic phenomenon. The atherosclerosis is a multi-organic arterial systemic disease, chronic and progressive, in which simultaneously damages coexist in different evolutional phases. The physiopathology and the clinical impact range as regards to the risk profile of the patients and the affected vascular bed: moreover, 70% of the deaths due to atherothrombosis are of cardiac origin. The cardiovascular disease (CVD) is the most usual cause of early mortality in Europe. Frequently, sudden death, the myocardial infarction or a devastating ictus are the first manifestations of CVD in young patients. Therefore, the early identification in vulnerable asymptomatic patients is essential. In this scenario, the cardiac imaging techniques reach an important role to detect groups of asymptomatic population with atherothrombotic high risk.

In Spain, the Cardiotens study estimated that the DM affects 70% of the patients with ischemic cardiopathy and 27% with cardiac dysfunction and is associated to 25% of the chronic auricular fibrillations and 12% of the valvulopathies. Moreover, in the diabetic patient other aggravating factors in the atherothrombotic process coexist, since 74% of them have arterial hypertension (AH), 49% has dyslipidemia, 41% obesity and 17% are smokers.

Cardiac imaging techniques in the cardiovascular risk assessment in asymptomatic diabetic patients

The global objectives of the cardiovascular prevention are to reduce the morbimortality of patients with high cardiovascular risk and help the patients with low and medium risk to keep a healthy life style. In the programs of cardiovascular prevention, the DM diagnosis is considered as an equivalent of a cardiac disease. Table 1 depicts the priorities in the clinical practice in terms of cardiovascular prevention. Logically, the essential objective would be to treat the involved developmental mechanisms at a molecular level, as well as the inflammation and instability of the plaque. The new techniques of cardiovascular imaging are a precise tool in order to study the atherosclerosis level but, to present; they are not sufficiently validated as regards to the coronary tree. Both the magnetic resonance imaging and the CAT scan have been revealed as tools of great value as regards to the non-invasive characterization of the extra coronary atheroma plaques, and in a not so far future, the coronary ones.

In the daily clinical practice, the cardiac imaging techniques and in particular the echocardiography exerts an outstanding role in the assessment of the asymptomatic diabetic patients’ risk. The guideline of the diabetes management published in 2007 starts with a diagnosis algorithm in which it is assumed the need of stratifying the coronary disease risk in all the diabetic patients and vice versa (figure 1). It is another matter if this tends to be profitable or possible. It is also unknown if it is convenient to repeat the diagnostic explorations periodically. According to this scheme, all the patients who have been diagnosed with DM have to undergo an electrocardiogram (ECG) and an echocardiography (ECHO). In the presence of a pathological ECG, it has to be ordered to perform an ECHO, both in diabetic patients and in non-diabetics, in order to rule out a structural cardiopathy. In the case of the asymptomatic diabetic patients with a normal ECG and taking in account the prevalence of diabetes in Spain, it would be interesting to determine the most adequate moment to perform it, within the evolution of the disease and to determine the diagnosis and prognosis value of the obtained information.

Transthoracic echocardiography

The information available at present refers to groups with high cardiovascular risk in a global manner.

<table>
<thead>
<tr>
<th>Table 1. Priorities in the cardiovascular prevention</th>
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<tbody>
<tr>
<td>• Patients with established cardiovascular disease</td>
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<tr>
<td>• Asymptomatic patients with high cardiovascular risk</td>
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<tr>
<td>– Multiple risk factors with an estimated risk of cardiovascular mortality of 10 years &gt;5%</td>
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<tr>
<td>– Type 2 diabetes mellitus, or T1D with microalbuminuria</td>
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<tr>
<td>• Only one risk factor associated to injury of target organ</td>
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<tr>
<td>• First line relatives of patients with early cardiovascular disease</td>
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<tr>
<td>• Health population without risk factors</td>
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The performance of a transthoracic ECHO is considered adequate in the “initial evaluation of the patients with arterial hypertension”, but to “repeat the studies systematically in patients without hypertensive cardiopathy or in those who have hypertensive cardiopathy without changes in the clinical condition” is not considered adequate.12 The transthoracic ECHO assesses the size and the form of the cardiac chambers, it allows to rule out the presence of valvulopathies and estimates feasibly the left ventricular mass and the systolic and diastolic function of the left ventricle (table 2).

The left ventricular hypertrophy (LVH) is a known cardiovascular risk factor (CRF); present in more of the 50% of the hypertensive patients.13 The ECG sensitivity for the detection of the LVH is low. The estimation of the left ventricular mass (LVM) through an ECHO is more accurate, and it is known that though the relation between LVM and CRF is a continuous variable, the determined cut points mark a prognosis difference (LVH >125 g/m² in men and >110 g/m² in women).14 Besides detecting LVH, the ECHO assesses its distribution as the concentric LVH (core wall-ratio ≥0.42 with an increase of the LVM) is the most potent cardiovascular risk marker.15 The insulin is one of the most powerful trophic factors. In this sense, it would be sufficient to explain the increase of the LVM in diabetic patients. In fact, the prevalence of the LVH in asymptomatic diabetic patients without AH reaches a 30% in different series. In the DM complicated with AH (in approximately 74% of the cases), the LVH is a common fact that marks more strict objectives for the control of the arterial pressure values (<125/75 mmHg).

Besides the ECHO allows assessing other parameters that are also predictors of cardiovascular events in asymptomatic patients as the left ventricular ejection fraction or the diastolic function rates. In asymptomatic patients with T2D it is frequent to find a diastolic dysfunction, both in relation with the AH and with early diabetic miocardiopathy phases. The diastolic dysfunction favors the dilatation of the left atrium and both are predictors of the atrium fibrillation.16

A certain interest as regards to the possibility of assessing the level of myocardial fibrosis though ECHO has arisen during the last years. Techniques have been implemented based on the reflectivity of the ultrasound, but are not used in a usual manner. At present, the magnetic resonance imaging is undoubtedly the most acute and reproducible technique to assess the level of the myocardial fibrosis.
dial fibrosis in a reliable manner. Moreover, in asymptomatic patients with ventricular dysfunction it allows differentiating the ischemic etiology of the non-ischemic with the late gadolinium enhancement techniques.

**Calcium assessment in the coronary territory**

As regards to the assessment of the silent obstructive coronary disease risk (CD), several studies have reported that the patients with DM have a higher prevalence and coronary calcium extension than the non diabetic patients. The presence of coronary calcium, quantified with the score developed by Agatston et al. is a atherosclerosis markers and of risk of events in the general population. The information about the role of the calcium score as risk predictor in diabetic patients is lower. The prevalence of the coronary calcium in asymptomatic diabetic patients is similar as in the non diabetics with obstructive CD. But a low calcium score in diabetic patients does not exclude a coronary disease. In the study of Raggi et al. that included 10,377 patients (903 with T2D) followed-up during more than 5 years, the mortality increased proportionally to the calcium score, both in diabetic patients and in non diabetic patients but it was higher in the diabetics. At present, there are no evidences in order to modify the therapeutic targets in diabetic patients considering the calcium score and, therefore, the performance of this test in diabetic patients and in patients with cardiovascular risk is doubtful.

**Non invasive coronary angiography**

Besides the assessment of the coronary calcium, the improvements in devices allow at present to perform a non invasive coronary angiography in a reliable manner by means of a multidetector computed tomography (MDCT). Different studies have proved that the non invasive coronary angiography has a high negative predictive value in low risk patients, reaching the 99%. It allows identifying different types of plaques (not calcified, mixed and calcified), as well as to recognize obstructive and non obstructive atherosclerotic injuries. From several initial studies, we know that the calcification represents the duration of the atherosclerosis, while the not calcified or mixed plaques are more frequent in patients with acute coronary syndromes.

The prevalence of the coronary disease in asymptomatic patients with T2D is higher than the one in the non diabetic population reaching the 80% according to a recent work of Scholte et al. A higher percentage of calcified and non calcified injuries in diabetic patients has been reported and a lower percentage of mixed plaques. The diagnosis precision of the technique is similar in diabetic patients. Schuijf et al. found a sensitivity and a specificity of 95% in the detection of the coronary stenosis, that was reduced to the 81% when including the segments in which the images were not of good quality. A high negative predictive value is kept, both in the study by segments and by patients.

The non invasive coronary angiography with MDCT is at present subjected to certain limitations, as the radiation (between 9 and 12 mSv), the extensive calcification of the coronary tree that dificults a correct assessment of the coronary arterial lumen, the movement devices and the use of iodated contrast. At present, this technique is recommended to exclude the coronary disease in asymptomatic patients of intermediate cardiovascular risk and is not accepted unanimously in asymptomatic diabetic patients (of high cardiovascular risk) (table 3).

**Diabetes and ischemic cardiopathy**

The conventional ergometry is a useful and cheap tool for the initial screening of a silent ischemic cardiopathy in diabetic patients. Its sensitivity (68%) and its specificity (77%) to detect a relevant coronary disease are similar to the ones of the diabetic patients. However, in this population up to a 30% of the tests are not conclusive due to the reduction of the exercise capacity, the peripheral arteriopathy or the neuropathy, and the specificity is a bit lower in relation to the microvascular affection. The ergometry contributes with prognosis information as regards to the functional capacity or the response to the arterial pressure exercise and the heart frequency. The studies of ischemia induction that incorporate cardiac imaging techniques (stress echography and isotopic studies) improve the sensitivity, the specificity and the diagnostic precision of the ergometry, though the presence of microvascular disease reducing again the diagnostic precision as regards to the obstructive coronary disease.

The stress ECHO allows performing in real time an assessment of the global and segmental wall motion of the left ventricle in basal situation and during the stress, studying the response to the exercise of the diastolic function parameters, of the systolic pulmonary pressure
or of the mitral insufficiency. The exercise ECHO is preferred because it allows a more physiologic assessment but many patients cannot walk due to a neuropathy or due to a peripheral vascular disease. The performance of a pharmacology stress ECHO in this group of patients also contributes with relevant prognosis information.\textsuperscript{38-40} In general; the patients referred for pharmacology stress show a higher risk of cardiovascular events in relation with the highest comorbidity of diabetes.

The principal controversy that exists at present for the performance of stress studies in asymptomatic diabetic patients is that the absence of ischemia is useful to define a profile of patient with a relative low risk of cardiovascular events, though only at short term and, besides, there is no available information about when and how the studies should be repeated.\textsuperscript{41,42} The present tendency is to perform studies for the detection of ischemia in diabetic patients with typical and atypical cardiac symptoms and in the asymptomatic patients that are considered of higher risk.\textsuperscript{43,44} Though it allows a better assessment of the risk, it is not practical or possible to perform systematic studies in asymptomatic patients.

### Table 3. Indications of the American Heart Association and of the American College of Cardiology\textsuperscript{31} for the performance of the non invasive coronary angiography with multidetector computed tomography and quantification of the coronary calcium in patients with high cardiovascular risk

<table>
<thead>
<tr>
<th>MDCT in symptomatic patients</th>
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<tbody>
<tr>
<td>• Thoracic pain study</td>
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<tr>
<td>– Coronary abnormality suspicion</td>
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<tr>
<td>• Patients with acute thoracic pain</td>
</tr>
<tr>
<td>– Doubtful indication in patients with high pre-test probability of coronary disease with ECG and normal enzymes.</td>
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<tr>
<td>• Doubtful stress and understandable studies</td>
</tr>
<tr>
<td>• Recent symptoms of cardiac insufficiency</td>
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<table>
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<tr>
<th>MDCT in asymptomatic patients</th>
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<tr>
<td>• There is no recommendation to perform the study in asymptomatic patients regardless of cardiovascular risk</td>
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### Quantification of coronary calcium

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<table>
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<tr>
<td>• Adequate in patients with intermediate cardiovascular risk</td>
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<tr>
<td>• Doubtful in patients with high cardiovascular risk</td>
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ECG: electrocardiogram; MDCT: multidetector computed tomography.

### Table 4. Indications of the stress echocardiography in patients with DM\textsuperscript{43}

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<table>
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<tbody>
<tr>
<td>• Typical and atypical cardiac symptoms with abnormal ECG or that do not walk, or non conclusive ergometry</td>
</tr>
<tr>
<td>• Prognosis stratification of ischemic cardiopathy: feasibility-ischemia</td>
</tr>
<tr>
<td>• Localization of the ischemia in symptomatic patients with known coronary disease</td>
</tr>
<tr>
<td>• Asymptomatic patients:</td>
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<tr>
<td>– Pathological basal ECG</td>
</tr>
<tr>
<td>– Peripheral arterial disease or carotid disease</td>
</tr>
<tr>
<td>– Sedentary life style</td>
</tr>
<tr>
<td>– Before doing an intense physical training in patients over 35 years old, with &gt;10 years of evolution of T2D or &gt;15 years of evolution of T1D</td>
</tr>
<tr>
<td>– Two or more associated risk factors: dislipemia, AH, nicotine poisoning, family history of early ischemic cardiopathy, microalbuminuria or macroalbuminuria</td>
</tr>
<tr>
<td>– Pre-operation assessment in high risk patients that will undergo a intermediate-high risk surgery</td>
</tr>
<tr>
<td>– Asymptomatic patients with calcium score of Agatston &gt;400</td>
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</tbody>
</table>

AH: arterial hypertension; DM: diabetes mellitus; ECG: electrocardiogram.

**Diabetic miocardiopathy of non coronary origin**

Some diabetic patients without evident signs of coronary or valvular disorder show a progressive impairment of the ventricular function that grants a chronic congestive cardiac insufficiency condition with an inadequate treat-
In the last published classification in miocardiopathy, the diabetic miocardiopathy appears as an independent entity within the group of dilated miocardiopathies. From the structural point of view, anatomical injuries have been found and other processes that take place with left ventricular dysfunction and ventricular dilatation. Thus, it can be observed hypertrophy of myocytes, interstitial fibrosis hyperplasia and perivascular, PAS deposits, thickness of the basal membrane and micro aneurisms in capillary and resistance vessels. Multiple factors seem to contribute to the development of the diabetic miocardiopathy, as the toxicity of the glucose on the myocytes, the toxic effect of the angiotensin and the aldosterone that trigger a miocardic fibrosis, the impairment in the homeostasis of the systolic calcium, the small vessel disease or the cardiac autonomic neuropathy.

The diabetic miocardiopathy is a progressive disease. The early studies, secondary to the toxicity of the hyperglycemia are not identifiable from the clinical point of view and the structural changes in the heart are insignificant if they are assessed through conventional imaging techniques. It will be essential to count with functional cardiac imaging techniques, reserved to the investigation at present, in order to determine the prognosis of these initial injuries and be able to stop its evolution. Initially, the left ventricular contractility is normal or even hyper-dynamic in relation to an excess of systolic calcium. However, these metabolic impairments have a deep cellular repercussion and trigger processes of apoptosis in the myocytes that are replaced by fibrous tissue. As consequence of the extracellular fibrosis, and to a lower extent of the cellular damage due to hyperglycemia, changes in the diastolic function start to appear. Then, structural changes with dilatation of the ventricular cavity and thickness of the myocardial wall appear. Initially, the ventricular function during rest periods is conserved, but it is possible to report a reduction of the contractile reserve in stress ECHO with exercise, or even a reduction of the ejection fraction with the effort. The process tends to an evolution towards a higher dilatation of the ventricular cavity with serious systolic dysfunction and congestive symptoms. Moreover, it has to be taken into account that the presence of other comorbidities derived from microangiopathic injuries, as polyneuropathy, has negative consequences on the systolic function and the heart auto-regulation capacity.

**Dyastolic dysfunction**

The ECHO is the choice technique for the study of the diastolic function. Indirect parameters of the bidimensional echography and M-mode are used in order to estimate the level of the diastolic dysfunction, together with parameters derived from the study through echo-Doppler of the intracardiac flows. The mitral filling flow and the pulmonary venous flow offer an initial assessment of the diastolic function but they are very dependent of the load conditions of the ventricle and the cardiac frequency and are not assessable in the presence of a relevant mitral valvulopathy. The new echocardiography techniques have allowed optimizing the evaluation of the diastolic function when studying the movement of the mitral ring. The relation of the protodiastolic speeds between the mitral echo-Doppler and the mitral ring allow estimating the pressures of the left ventricular filling in a reliable manner. Table 5 and figure 2 depict the different studied parameters.

The isolated diastolic dysfunction is relatively frequent in studies performed in asymptomatic diabetic patients (more than 60% of the cases) and is more usual in patients with T2D, likely associated to the additional increases in the accumulation of collagen in relation to the health and an inadequate glycemic control. The initial stage is characterized by an impairment in the myocardial relaxation (E/A <1 and extended DT). At this moment the dysfunction is reversible and is more related to the metabolic impairments than with a process of advanced fibrosis.

The second stage represents a moderate diastolic dysfunction in relation to the perivascular and interstitial fibrosis. This is a pseudonormal mitral filling pattern. The patients might show effort dyspnea and it is possible to report an increase in the left atrium pressures that start

### Table 5. Parameters used in the assessment of the diastolic function. Recommendations of the European Society of Cardiology

<table>
<thead>
<tr>
<th>Parameters used in the assessment of the diastolic function. Recommendations of the European Society of Cardiology</th>
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<tbody>
<tr>
<td>• Volume of the left atrium</td>
</tr>
<tr>
<td>• Mass of the left ventricle</td>
</tr>
<tr>
<td>• Mitral filling pattern: speed of the E wave, speed of the A wave, time deceleration (TD)</td>
</tr>
<tr>
<td>– Propagation speed of the mitral flow (Ps)</td>
</tr>
<tr>
<td>– Echo-Doppler of pulmonary veins: relation wave S/wave D</td>
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<tr>
<td>– Tissular echo-Doppler of the mitral ring: speed of the wave E’</td>
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</table>
In this phase, the stress ECHO with exercise provides useful clinical information, as it is possible to study the diastolic basal pattern and the improvement or worsening of it with the effort in asymptomatic patients or with effort dyspnea. The observed changes with the physical activity provide an important prognosis information about the level of the myocardial disorder, the functional capacity and the systolic function with the exercise. In the final phase of the diastolic dysfunction we find a mitral filling pattern with restrictive physiology and it is frequent to report high filling pressures with quotients $E'/E$ higher than 16 and $E/Vp>2$, that are correlated with mean pulmonary capillary pressures of more than 18 mmHg. In these cases with high filling pressures in basal situation, the exercise echography does not provide additional information as regards to the functional capacity.

**Systolic dysfunction**

The biodimensional ECHO allows a non invasive assessment of the global systolic function of both ventricles and of the impairments in the segmental contractility, with a sensitivity of 94% in the detection of the contractility impairments. It is a simple and cheap technique that provides a lot of information bedside. At present, there is a great quantity of available methods to estimate the systolic function (table 6 and figure 3). The European Society of Cardiology recommends to quantify the diameters of the left ventricle in systole and diastole and to estimate the left ventricle telediastolic volume (LVTDV) and the left ventricle telesystolic volume (LVTSV) in order to estimate the left ventricle ejection fraction (LVEF) through the Simpson method. As regards to the right ventricle, it is not possible to quantify the ejection fraction with the bidimensional ECHO in a reliable manner and the reports should refer to the telediastolic volume diameter of the right ventricle, as well as indirect data of the systolic function of the right ventricle that have been validated with a magnetic resonance imaging, as the displacement of the tricuspid ring (TAPSE) or the systolic wave of the tissular echo-Doppler of the tricuspid ring (S').

In order to analyze the segmental contractility, a score from 1 to 5 is appointed to each one of the 17 segments proposed by the American Society of Echocardiography considering if the thickness of the wall is normal (1= normokinetic; it has to increase more than 40% during the systole), the systolic thickness is under the 30% (2= hypokinetic) the systolic thickness is under the 10% (3= ak...
inetic), it presents systolic expansion of the wall towards the pericardium (4= dyskinetic) or it is aneurismatic (5= aneurism). On the basis of this analysis it can be determined, in a semi-quantitative manner, the global extension of the segmental contractility abnormalities though the left ventricular contractility index (LVCI = addition of the scores of each segment/number of the analyzed segments), that under normal conditions is 1 (16/16) and increases as the extension of the ischemia does.

The assessment of the segmental contractility is limited by an inadequate definition of the endocardic border, with the conventional equipments up to 25% of the patients due to frequent situations in the daily practice, as obesity, the chronic lung disease or the thoracic deformations, that limit the acoustic window. The use of the echo-potentiators together with the harmonic imaging improves the visualization of the different segments especially in the anterolateral and apical area. The use of echo-potentiators is indicated if the basal image does not allow an adequate assessment of more than two segments. Figure 4 sums up the criteria established by the European Society of Cardiology for the diagnosis of cardiac insufficiency.

In patients with cardiac insufficiency symptoms in absence of coronary disease, the exercise ECHO evaluates the behaviours of the pressures of the left ventricle filling, of the mitral insufficiency and the pulmonary systolic pressure. The assessment of these parameters is useful, as it allows registering the clinical evolution and the treatment of the cardiac insufficiency in a non invasive manner.
manner. Frequently, even in the absence of epicardic coronary arteries disease, these patients show different impairments in the segmental contractility during the stress or even a dilatation of the ventricular cavity due to microvascular injuries or scarce contractile reserve. Therefore, the stress ECHO has a limited value in the diagnosis of the diabetic miocardiopathy due to its high percentage of false positives.44,68

In the context of the diabetic miocardiopathy is where the cardiac magnetic resonance has an added value compared to the other techniques. The techniques of later enhancement allow studying the distribution of the fibrosis areas and the feasibility of the different segments to guide the treatment of the late phases of the cardiac insufficiency, as well as to differentiate the ischemic etiology dysfunction from the non ischemic one.

Conclusions
During the last decades, the incidence of the T2D and the cardiac insufficiency reach epidemic levels. The diabetic patients are characterized by an increase in the prevalence of the cardiac insufficiency, both in relation to the disease itself and in the associated risk factors. The techniques of the cardiac imaging have a well defined value in the diagnosis of the cardiac complications of the diabetes and a more doubtful prognosis value. Any diabetic patient should undergo an ECG and an ECHO. The moment to perform the ECHO depends on the presence of the ECH impairments, the symptoms and the estimated global risk. The performance of stress tests would be useful in the diabetic patients without a demonstrated EC in order to rule out a silent ischemia and to assess the functional level, and the same criteria are applied to patients with EC symptoms or diagnosis than to the non diabetic coronary patients.

Declaration of potential conflict of interest
T. López Fernández, M. Moreno, E. Refoyo, G. Guzmán and J. López–Sendón state that there are no potential conflicts of interest as regards to this work.

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