Consensus Statement of Non-invasive Cardiovascular Imaging in Adults/Abridged Version

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Rev Argent Cardiol 2017;85:147-179. http://dx.doi.org/10.7775/rac.v85.i2.10252

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INTRODUCTION

The present Consensus Statement of Non-Invasive Cardiovascular Imaging in Adults presents most of the diagnostic methods for the most frequent cardiovascular diseases.
The authors would like to point out that:
We understand that there are certain diseases and/or specific situations that are not addressed in this Consensus.
The recommendations are guidelines and suggestions that refer to specific diseases and patients in general, and their application will be at the discretion of the attending physician based on the availability of the method, experience of the center and individual characteristics of each specific case.
In certain recommendations, more than one method can be applied indistinctly, so when a method is recommended as Class I or another level of evidence, it can be replaced by an alternative one with an equal level of recommendation, applying the same considerations as those recommended in the previous paragraph.

METHODOLOGY

From the methodological point of view, a working group was formed to cover each specific imaging method (Committees). All members had access to review the document, in order to standardize criteria and reduce discordances. To determine the Recommendation Class achieved in this Consensus, the following classification was used:

- **Class I:** Conditions for which there is evidence and/or general agreement that the treatment or procedure is beneficial, useful and effective. A Class I indication does not mean that it is the only acceptable procedure.
- **Class II:** Conditions for which there are conflicting evidences and/or opinion differences on the usefulness/effectiveness of the procedure or treatment.
- **Class IIa:** The weight of evidence/opinion is in favor of the usefulness /effectiveness.
- **Class IIb:** The usefulness /effectiveness is less well established by the evidence/opinion.
- **Class III:** Conditions for which there is evidence and/or general agreement that the procedure or treatment is not useful/effective and in some cases can be harmful.

Regarding the Level of evidence on which the consensus recommendation is based, the following outline was used:

- *Level of evidence A:* Solid evidence from controlled clinical trials with randomized assignment or meta-analysis. It involves the analysis of multiple groups of population at risk (3 to 5). General consistency in the course and magnitude of the effect.
- *Level of evidence B:* evidence derived from a single, controlled clinical trial with randomized assignment or from large studies without randomized assignment. The population groups at risk analyzed are more limited. (2 or 3)
- *Level of evidence C:* Consensus or expert opinion and/or small studies or retrospective studies or from registries.

Finally, this is an abridged version, both in its content and references. The full version may be consulted on the website of the Argentine Society of Cardiology.

Conflicts of interest

See authors' conflicts of interest forms in the web / Supplementary Material.

ECOCARDIOGRAPHY

RECOMMENDATIONS FOR THE ADEQUATE USE OF TRANTHORACIC AND TRANESOPHAGEAL ECHOCARDIOGRAPHY IN HEART VALVE DISEASES

Transthoracic echocardiography to assess valve function: murmurs or clicks

Recommendation	Class	Level of evidence
Initial assessment if structural or heart valve disease is suspected.	I	C
Initial assessment in the absence of symptoms or signs of structural or heart valve disease.	III	C
Reassessment in patients without heart valve disease with previous echocardiography without changes in the clinical status or cardiovascular examination.	III	C
Reassessment of known heart valve disease with changes in clinical status or cardiovascular examination or as a therapeutic guideline.	I	A
Follow-up monitoring (<3 years) of mild valve stenosis without changes in clinical status or cardiovascular examination.	III	C
Follow-up monitoring (≥ 3 years) of mild valve stenosis without changes in clinical status or cardiovascular examination.	I	C
Routine monitoring (<1 year) of moderate or severe valve stenosis without changes in clinical status or cardiovascular examination.	III	C
Routine monitoring (≥1 year) of moderate or severe valve stenosis without changes in clinical status or cardiovascular examination.	I	C
Routine monitoring in mild regurgitation.	III	C
Routine monitoring (<3 years) of mild heart valve disease without changes in clinical status or cardiovascular examination.	III	C
Routine monitoring (≥3 years) of mild heart valve disease without changes in clinical status or cardiovascular examination.	I	C
Routine monitoring (<1 year) of moderate or severe heart valve regurgitation without changes in clinical status or cardiovascular examination.	IIb	C
Routine monitoring (≥1 year) of moderate or severe heart valve regurgitation without changes in clinical status or cardiovascular examination.	I	C

Transthoracic echocardiography in prosthetic valve assessment

Recommendation	Class	Level of evidence
Initial postoperative assessment of heart valve replacement to establish baseline registry.	I	A
Follow-up monitoring of heart valve prosthesis (<3 years after replacement) if unknown or prosthetic dysfunction is suspected.	IIa	C
Follow-up monitoring of heart valve prosthesis (≥3 years after implantation) if unknown or prosthetic dysfunction is suspected.	I	C
Assessment of heart valve prosthesis with suspected dysfunction or change in functional class (clinical status) or at cardiovascular examination.	I	A
Reassessment of known prosthetic heart valve dysfunction, when management or therapy is changed.	I	A

Transthoracic echocardiography in infectious endocarditis (native or prosthetic heart valve)

Recommendation	Class	Level of evidence
Initial assessment of suspected infective endocarditis with positive blood cultures or new murmur.	I	A
Transient fever without evidence of bacteremia or new murmur.	III	C
Transient bacteremia with a pathogen not typically associated with infective endocarditis or with change in the clinical status and/or documented source of non-endovascular infection.	IIb	C
Reassessment of high-risk infective endocarditis due to progression, complication, or changes in the clinical status or cardiac examination.	I	A

Transthoracic echocardiography in aortic disease assessment

Recommendation	Class	Level of evidence
Ascending aorta assessment in the presence of suspected or known connective tissue disease or genetic condition predisposing to aneurysm or dissection (e.g. Marfan syndrome).	I	A
Reassessment of known ascending aortic dilatation or history of dissection in order to establish a baseline expansion registry or when the expansion rate is excessive.	I	A
Reassessment of known ascending aortic dilatation or history of dissection with change in the clinical status or cardiac examination, or findings that might alter management or treatment.	I	A
Follow-up reassessment of known ascending aortic dilatation or history of aortic dissection without changes in the clinical status or cardiac examination when the findings do not modify the management strategy or therapy.	IIa	C

RECOMMENDATIONS FOR THE ADEQUATE USE OF THREE-DIMENSIONAL ECHOCARDIOGRAPHY IN HEART VALVE DISEASES

Indications for three-dimensional transesophageal echocardiography in mitral valve disease

Recommendation	Class	Level of evidence
Study of mitral valve disease etiology, extension and location prior to surgery to evaluate repair feasibility.	IIa	C
Periprosthetic mitral regurgitation to evaluate size, number of defects, location and extent of paravalvular dehiscence.	IIa	C
3D study of severe rheumatic mitral valve stenosis to determine the area and evaluate treatment feasibility by percutaneous valvuloplasty.	IIa	C
3D transesophageal echocardiography as a hemodynamic laboratory guide in periprosthetic dehiscence closure procedure, percutaneous treatment of native mitral valve regurgitation (mitral clips), and mitral balloon valvuloplasty.	IIa	C
3D mitral valve study when regurgitation is suspected due to the presence of cleft or disease at the commissural level.	IIb	C
3D color Doppler study to determine the degree of mitral valve regurgitation through information of vena contracta area.	IIb	C
3D mitral valve study at the exit of extracorporeal circulation following a mitral valve repair procedure.	IIb	C
3D mitral valve disease study in patients not considered for the possibility of a therapeutic procedure.	III	C

3D: Three-dimensional

Symptomatic valve prosthesis

Recommendation	Class	Level of evidence
Study of the LVOT, aortic valve and aortic root anatomy in the assessment prior to percutaneous treatment of severe aortic stenosis.*	IIa	C
Study of LVOT, aortic valve and aortic root anatomy in the assessment of possible valve and/or aortic root repair surgery.	IIb	C

* Computed tomography is the first-choice method. LVOT: Left ventricle outflow tract.

Indications for transesophageal echocardiography in pulmonary and tricuspid valve disease

Recommendation	Class	Level of evidence
Study of tricuspid valve disease.	IIb	C
Study of pulmonary valve disease.	III	C

RECOMMENDATIONS FOR THE ADEQUATE USE OF STRESS ECHOCARDIOGRAPHY IN HEART VALVE DISEASES

Asymptomatic chronic heart valve disease

Recommendation	Class	Level of evidence
Mild mitral stenosis.	III	C
Moderate mitral stenosis.	IIb	C
Severe mitral stenosis.	IIa	C
Mild aortic stenosis.	III	C
Moderate aortic stenosis.	IIb	B
Severe aortic stenosis.	IIa	B
Mild MR.	III	C
Moderate MR.	IIb	B
Severe MR (determines the surgical moment and prognosis in the functional valves).	IIa	A
Mild AR.	III	C
Moderate AR.	III	C
Severe AR.	IIb	B

MR: Mitral regurgitation. AR: Aortic regurgitation

Symptomatic chronic heart valve disease

Recommendation	Class	Level of evidence
Mild mitral stenosis.	IIb	C
Moderate mitral stenosis.	I	B
Severe mitral stenosis.	III	C
Mild aortic stenosis.	III	C
Moderate aortic stenosis.	IIa	B
Moderate or severe aortic stenosis.	III	C
Severe aortic stenosis with low gradient and systolic dysfunction (dobutamine).	I	A
Mild aortic stenosis+coronary artery disease.	IIa	B
Mild MR.	IIb	B
Moderate MR.	IIa	C
Severe MR.	III	C
Mild AR.	III	C
Moderate AR.	III	C
Severe AR.	III	B

MR: Mitral regurgitation. AR: Aortic regurgitation

Indications for three-dimensional transesophageal echocardiography in aortic valve disease

Recommendation	Class	Level of evidence
Mitral prosthesis with normal or slightly increased gradients.	IIa	B
Aortic prosthesis with normal or increased gradients.	III	C

RECOMMENDATIONS FOR THE ADEQUATE USE OF ECHOCARDIOGRAPHY IN CARDIOMYOPATHIES

Recommendation	Class	Level of evidence
Initial assessment of suspected or known cardiomyopathy (signs or symptoms or complementary studies).	I	B
Reassessment of known cardiomyopathy with changes in the clinical stage, physical examination or to guide treatment.	I	B
Reassessment of cardiomyopathy after interventional or surgical treatment.	I	B
Assessment for hereditary cardiomyopathy screening in first-degree relatives.	I	B
Baseline assessment and monitoring reassessments in patients receiving treatment with cardiotoxic drugs or mediastinal radiotherapy.	I	B
Routine monitoring ≥1 year of known cardiomyopathy without changes in the clinical stage or physical examination.	IIa	C
Routine monitoring <1 year of known cardiomyopathy without changes in the clinical stage or physical examination.	III	C

Cardiomyopathy assessment with transesophageal echocardiography and Doppler

Recommendation	Class	Level of evidence
Transthoracic echocardiography and Doppler adjuvant or subsequent assessment when the image is suboptimal to obtain a diagnostic study of cardiomyopathy.	I	B
Monitoring during interventional procedures in cardiomyopathy (including septal ablation and biopsy).	I	B
Monitoring during surgical procedures in cardiomyopathy.	I	B
Routine assessment to obtain a diagnostic study of cardiomyopathy.	III	C

Cardiomyopathy assessment with stress echocardiography and Doppler

Recommendation	Class	Level of evidence
Exercise response assessment of known hypertrophic cardiomyopathy (especially left ventricular outflow tract gradient in hypertrophic cardiomyopathy).	IIa	B
Routine assessment for cardiomyopathy study.	III	C

Cardiomyopathy assessment with transthoracic and/or transesophageal echocardiography and Doppler with contrast

Recommendation	Class	Level of evidence
Monitoring during interventional procedure (septal ablation) in hypertrophic cardiomyopathy.	I	B
Transthoracic echocardiography and Doppler adjuvant or subsequent assessment to obtain a diagnostic study of apical hypertrophic cardiomyopathy when the image is suboptimal.	IIa	B
Transthoracic echocardiography and Doppler adjuvant or subsequent assessment for the diagnosis of fibrosis in hypertrophic cardiomyopathy.	IIb	B
Routine assessment to obtain a diagnostic study of cardiomyopathy.	III	C

Cardiomyopathy assessment with echocardiography and three-dimensional Doppler

Recommendation	Class	Level of evidence
Reassessment of known cardiomyopathy to guide interventional or surgical treatment.	IIb	B
Reassessment of cardiomyopathy after interventional or surgical treatment.	IIb	B
Initial assessment of known or suspected cardiomyopathy (signs or symptoms or complementary studies).	III	C
Assessment for screening of hereditary cardiomyopathy in first degree relatives.	III	C
Baseline assessment and monitoring reassessments in patients receiving treatment with cardiotoxic drugs or mediastinal radiotherapy.	III	C
Routine monitoring of known cardiomyopathy without changes in clinical stage or physical examination.	III	C

Cardiomyopathy assessment with new echocardiography and Doppler technologies (strain, Doppler strain rate or one-dimensional, two-dimensional and three-dimensional speckle tracking)

Recommendation	Class	Level of evidence
Transthoracic or transesophageal echocardiography and Doppler adjuvant or subsequent assessment for the study of cardiomyopathy.	IIa	B
Routine assessment to obtain a diagnostic study of cardiomyopathy.	III	C

RECOMMENDATIONS FOR THE ADEQUATE USE OF ECHOCARDIOGRAPHY IN PERICARDIAL DISEASES

Recommendation	Class	Level of evidence
Initial assessment of known or suspected pericardial disease (symptoms or signs or complementary studies).	I	B
Severe injury due to deceleration or chest trauma, whenever possible, or due to suspected pericardial effusion (symptoms or signs or complementary studies).	I	B
Reassessment of known pericardial effusion with changes in clinical stage, physical examination or to guide treatment.	I	B
Baseline assessment and monitoring reassessments in patients receiving treatment with cardiotoxic drugs or mediastinal radiotherapy.	I	B
Routine monitoring of small pericardial effusion without changes in clinical stage or physical examination.	III	C

Assessment of pericardial diseases with transesophageal echocardiography and Doppler

Recommendation	Class	Level of evidence
Transthoracic echocardiography and Doppler adjuvant or subsequent assessment when the image is suboptimal to obtain a pericardial disease diagnostic study.	IIa	B
Monitoring during interventional pericardial disease procedures (pericardiocentesis).	IIb	B
Monitoring during surgical pericardial disease procedures.	IIb	B
Routine assessment to obtain a pericardial disease diagnostic study.	III	C

Assessment of pericardial diseases with stress echocardiography and Doppler

Recommendation	Class	Level of evidence
Transthoracic and/or transesophageal echocardiography and Doppler adjuvant or subsequent assessment to obtain a pericardial disease study.	III	C

Assessment of pericardial diseases with transthoracic and/or transesophageal echocardiography and Doppler with contrast

Recommendation	Class	Level of evidence
Monitoring during interventional pericardial disease procedures (pericardiocentesis).	IIb	B

Assessment of pericardial diseases with three-dimensional echocardiography and Doppler

Recommendation	Class	Level of evidence
Transthoracic and/or transesophageal echocardiography and Doppler adjuvant or subsequent assessment to obtain a pericardial disease study.	IIb	B

RECOMMENDATIONS FOR THE ADEQUATE USE OF ECHOCARDIOGRAPHY IN THE STUDY OF MASSES AND TUMORS

Tumor and mass assessment with transthoracic echocardiography and Doppler

Recommendation	Class	Level of evidence
Initial assessment of known or suspected tumor or mass (signs or symptoms or complementary studies).	I	B
Reassessment of a known tumor or mass with changes in the clinical stage, physical examination or to guide treatment.	I	B
Reassessment of a tumor or mass after interventional or surgical treatment.	I	B
Assessment for the screening of a hereditary tumor or mass in first-degree relatives.	I	B
Baseline assessment and monitoring reassessments in patients receiving treatment with cardiotoxic drugs or mediastinal radiotherapy.	I	B
Routine monitoring ≥1 year of a known tumor or mass without changes in clinical stage or physical examination.	IIa	C
Routine monitoring <1 year of a known tumor or mass without changes in clinical stage or physical examination.	III	C

Tumor and mass assessment with transesophageal echocardiography and Doppler

Recommendation	Class	Level of evidence
Adjuvant or subsequent assessment of transthoracic echocardiography and Doppler to obtain a diagnostic study of a tumor or mass when the image is suboptimal.	I	B
Monitoring during interventional procedures in a tumor or mass (including biopsy).	I	C
Monitoring during surgical procedures in a tumor or mass.	I	C
Routine assessment to obtain a diagnostic study of a tumor or mass.	III	C

RECOMMENDATIONS FOR THE ADEQUATE USE OF ECHOCARDIOGRAPHY IN THE STUDY OF THE EMBOLIC SOURCE

Recommendation	Class	Level of evidence
Patient of any age with sudden occlusion of a major brain artery.*	I	C
Young patient (less than 45 years) with neurological vascular events.*	I	C
Patient over 45 years of age with neurological vascular events without evidence of cerebrovascular disease or other patent cause.*	I	C
Patient in whom a clinical therapeutic decision (anticoagulants, etc.) depends on the echocardiographic results.*	I	C
Patient with suspected embolic disease and cerebrovascular disease of uncertain significance.*	I	C
Patient with neurological event and intrinsic cerebrovascular disease whose nature is enough to cause the clinical event.*	IIb	C
Patient in whom the echocardiogram result has no impact on the decision to introduce anticoagulant therapy, nor does it otherwise alter the diagnostic or therapeutic approach.	III	C

*Transesophageal echocardiography may provide additional information. It would be indicated according to clinical suspicion of embolic event, clinical context, potential conduct change, transthoracic echocardiogram results and transesophageal echocardiography availability.

RECOMMENDATIONS FOR THE ADEQUATE USE OF ECHOCARDIOGRAPHY IN CORONARY HEART DISEASE

Indications for transthoracic echocardiography in asymptomatic patients with suspected coronary artery disease

Recommendation	Class	Level of evidence
Echocardiography is recommended in asymptomatic patients with evidence of structural or functional alteration in other studies (e.g., but not limited to: ECG, chest X-ray, graded exercise test).	I	B
Cardiovascular risk assessment in asymptomatic adults.	III	B

Indications for transthoracic echocardiography in chronic stable angina

Recommendation	Class	Level of evidence
Resting echocardiogram for structural and functional assessment in patients with symptoms compatible with effort angina.	I	B
Periodic repetitive assessment (intervals >1 year) with resting echocardiogram in patients with chronic stable angina without changes in clinical condition.	IIb	C
Resting echocardiogram to assess ventricular function in previously evaluated patients (with MSCT, SPECT, CMR or echocardiogram) showing normal systolic function and without changes in clinical status.	III	C
Repeated resting echocardiography assessment at < 1 year intervals for patients without changes in clinical status and with no planned therapeutic change.	III	C

MSCT: Multislice computed tomography. SPECT: Single photon emission computed tomography. CMR: Cardiac magnetic resonance

Indications for transthoracic echocardiography in ST-segment elevation acute coronary syndromes

Recommendation	Class	Level of evidence
In patients with left ventricular systolic function impairment, ejection fraction measurement is indicated at least 40 days after the acute event for risk assessment and ICD indication.	I	A
Initial assessment of ventricular function and infarct size in patients with diagnosis of ST-segment elevation acute coronary syndrome.	I	B
Segmental wall motion assessment in patients without chest pain but with other symptoms compatible with infarction or biomarkers indicative of ongoing infarction.	I	C
Suspected mechanical complication of myocardial infarction.	I	C
Ventricular function reassessment during acute coronary syndrome hospitalization if the results will guide therapy.	I	C
Suspicion of acute coronary syndrome with chest pain and nonconclusive electrocardiogram.	I	C

Indications for transthoracic echocardiography in non-ST-segment elevation acute coronary syndromes

Recommendation	Class	Level of evidence
Echocardiogram in patients with documented ischemia, to assess ventricular function, as a prognostic marker and to guide therapy.	I	B
Echocardiogram in patients with suspected non-ST-segment elevation acute coronary syndrome, to assess segmental wall motion and to rule out or confirm differential diagnoses (aortic dissection, pulmonary thromboembolism, hypertrophic cardiomyopathy, severe aortic stenosis, pericardial effusion).	I	B

RECOMMENDATIONS FOR THE ADEQUATE USE OF ECHOCARDIOGRAPHY IN NONCARDIAC SURGERY

Indications for transthoracic echocardiography in preoperative assessment of noncardiac surgery

Recommendation	Class	Level of evidence
Resting echocardiogram for unstable patients (acute heart failure, unstable angina, infarction in the last 30 days and residual ischemia, significant arrhythmias, symptomatic valve diseases) requiring planned surgery.	I	C
Resting echocardiogram to assess ventricular function in patients with planned high-risk surgery.	IIa	C
Resting echocardiogram to assess ventricular function in patients with unidentified cause of dyspnea.	I	C
Resting echocardiogram to assess ventricular function in patients with known heart failure and symptom worsening.	I	C
Echocardiogram for ventricular function reassessment in stable patients with known cardiomyopathy.	IIb	C
Resting echocardiogram to assess ventricular function in patients with planned low or intermediate risk surgery.	III	B
Resting echocardiogram to assess ventricular function in patients requiring emergency surgery.	III	C

Indications for perioperative echocardiography in noncardiac surgery

Recommendation	Class	Level of evidence
Patients developing severe and sustained hemodynamic impairment during or in the immediate postoperative period of noncardiac surgery.	I	C
TTE/TEE in patients with abnormal ST-segment changes during intraoperative monitoring of noncardiac surgery.	IIa	C
TEE monitoring can be considered in patients at high risk of developing ischemia during major noncardiac surgery.	IIb	C
TTE monitoring can be considered in patients at high risk of hemodynamic impairment during major noncardiac surgery.	IIb	C
TEE monitoring can be considered for patients with severe valve diseases during noncardiac surgery with predicted large hemodynamic changes.	IIb	C

TTE: Transthoracic echocardiography. TEE: Transesophageal echocardiography.

RECOMMENDATIONS FOR THE ADEQUATE USE OF ECHOCARDIOGRAPHY TO DETECT VIABILITY IN PATIENTS WITH CHRONIC ISCHEMIC HEART DISEASE.

Viability detection in patients with chronic ischemic heart disease. Indications for dobutamine echo-stress

Recommendation	Class	Level of evidence
To detect the presence and extent of viable myocardium in patients with chronic coronary artery disease and ventricular dysfunction.	I	B
To detect viability in patients with left ventricular dysfunction and extremely dilated ventricles with extensive areas of myocardial necrosis.	IIb	B

RECOMMENDATIONS FOR THE ADEQUATE USE OF ECHOCARDIOGRAPHY IN ADULT CONGENITAL HEART DISEASE

Indications for echocardiography in adult patients with congenital heart disease

Recommendation	Class	Level of evidence
Patients with clinical suspicion of congenital heart disease.	I	C
Patients with known congenital heart disease, when there is a change in clinical findings at follow-up.	I	C
Patients with known congenital heart disease in whom there are doubts about the original diagnosis or when the precise nature of structural or hemodynamic abnormalities is not clear.	I	C
Periodic Doppler echocardiography in patients with congenital heart disease requiring ventricular function and/or atrio-ventricular valve regurgitation and/or pulmonary artery pressure monitoring.	I	C
To direct catheter valvulotomy or radiofrequency ablation in the presence of complex cardiac anatomy.	I	C
To direct interventional catheterizations such as closure of ASD, perimembranous VSD, or fenestrations in extracardiac tubes.	I	C
Pregnant women with a history of operated or non-operated congenital heart disease at the beginning of each trimester and at the end of the last trimester.	I	C
Annual or biannual follow-up Doppler echocardiography, in patients with known and hemodynamically significant congenital heart disease without evident changes in clinical condition.	IIa	C
Multiple repeated Doppler echocardiograms in patients with simple congenital heart disease, repaired or operated, without changes in their clinical condition.	III	C

ASD: Atrial septal defect. VSD: Ventricular septal defect.

Indications for three-dimensional transesophageal echocardiography in atrial septal defect

Recommendation	Class	Level of evidence
Study of ostium secundum type atrial septal defect to assess the feasibility of percutaneous closure and to guide the procedure.	IIa	C
As a guide for transeptal puncture in the hemodynamic laboratory.	IIa	C

RECOMMENDATIONS FOR THE ADEQUATE USE OF CONTRAST IN ECHOCARDIOGRAPHY

Use of contrast with agitated saline solution

Recommendation	Class	Level of evidence
Diagnosis and assessment of atrial septal defect.	I	B
Diagnosis and assessment of patent foramen ovale.	I	B
Diagnosis of extracardiac communication (aortopulmonary fistula, hepatopulmonary syndrome).	I	B
Opacification of right heart chambers (definition of masses, anatomical abnormalities, etc.).	I	B
Diagnosis and assessment of persistent left superior vena cava.	I	B
Diagnosis and assessment of ventricular septal defect.	IIa	B
Diagnosis and assessment of coronary fistula.	IIa	B
Diagnosis and post-operative or percutaneous post-procedurural assessment of congenital heart disease (Senning, Mustard, Fontan procedures, interatrial or interventricular septal defect closures).	IIa	B
Placement of a bicaval dual-lumen catheter for veno-venous oxygenation.	IIa	B
Diagnosis and assessment of persistent ductus.	IIb	B
Doppler signal enhancement (tricuspid regurgitation for pulmonary systolic pressure assessment).	IIa	B

Use of contrast (not commercially available in Argentina, only available for research)

Recommendation	Class	Level of evidence
Left ventricular opacification to improve volume and ventricular function assessment or due to suboptimal ultrasonic window.	IIb	A
Left ventricular opacification to assess structural abnormalities such as apical hypertrophic cardiomyopathy, non-compacted ventricle, apical thrombus, ventricular pseudoaneurysm.	IIB	A
Left ventricular opacification for border detection (only in case of no visualization of two or more consecutive segments in a transthoracic study).	IIb	B
Diagnosis of coronary artery disease with echo-stress.	IIb	B
Myocardial perfusion for chronic and acute coronary artery disease (at rest).	IIb	B
Diagnosis of myocardial viability.	IIb	B

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NUCLEAR CARDIOLOGY

RECOMMENDATIONS FOR MYOCARDIAL PERFUSION IN ASYMPOMATIC SUBJECTS

Recommendations of myocardial perfusion in asymptomatic subjects with possible high risk of coronary artery disease

Recommendation	Class	Level of evidence
Patients at high pretest risk (ATP III).	IIa	B
Strong family history of coronary artery disease.	IIa	B
Diabetic patients with abnormal ECG, peripheral vascular disease, heart failure.	IIa	B
Peripheral vascular disease.	IIa	B
Myointimal thickening.	IIb	C
Undiagnosed LV dysfunction.	IIa	B
Calcium score >400.	IIa	B
New onset AF (as part of an assessment when the etiology is not clear).	IIb	B
High or moderate risk of coronary disease syncope.	IIa	B
Patients resuscitated from sudden death or presence of ventricular tachycardia.	IIa	B

ECG: Electrocardiogram. LV: Left ventricular. AF: Atrial fibrillation.

CORONARY HEART DISEASE DIAGNOSIS

A. Assessment of atypical chest pain or ischemic equivalents (non-acute)

Recommendation	Class	Level of evidence
Intermediate or high probability of coronary artery disease (myocardial perfusion study with exercise or pharmacological stress in complete LBBB). Low probability with calcium score >400.	I	B
Low probability of coronary artery disease with non-interpretable resting ECG or unable to perform exercise.	IIa	B

LBBB: Left bundle branch block. ECG: Electrocardiogram

B. Clinical situations or symptoms compatible with angina (non-ACS)

Recommendation	Class	Level of evidence
All previous situations of high and intermediate probability of coronary artery disease and with **compatible symptoms or suspected angina**.	I	B
Patients with high or intermediate probability of coronary artery disease and **ECG abnormalities associated with chest pain.**	I	B
Patients with abnormal stress test or imaging study in whom coronary artery disease is suspected.	I	B
Patients with calcium score >400.	I	B

ACS: Acute coronary syndrome. ECG: Electrocardiogram.

C. Lesion severity assessment once coronary artery disease diagnosis has been made

Recommendation	Class	Level of evidence
Identification of coronary artery stenosis **hemodynamic significance** after MSCT or CA.	I	B

MSCT: Multislice computed tomography. CA: Coronary angiography.

D. Acute chest pain situations consulting for possible ACS

Recommendation	Class	Level of evidence
Patients with: a) Normal, non-interpretable (complete LBBB or pacemaker) or pathological (non-ST-segment elevation) ECG. b) Negative or borderline troponin. c) TIMI score: high or moderate risk.	I	B
Patients with: a) Pathological ECG (non-ST-segment elevation). b) Negative or borderline troponin. c) TIMI score: low risk.	IIa	B
Patients with: a) Non-interpretable ECG (complete LBBB or pacemaker). b) Negative troponin. c) TIMI score: low risk.	I	B

ACS: Acute coronary syndrome. LBBB: Left bundle branch block. ECG: Electrocardiogram

ACUTE MYOCARDIAL INFARCTION

A. ST-segment elevation acute myocardial infarction

Recommendation	Class	Level of evidence
To detect **infarct size or myocardium at risk for residual ischemia** in patients who received thrombolytic therapy without pre-discharge catheterization or non-reperfused infarctions (exercise stress or dipyridamole gated SPECT).	I	B
To assess infarct size and residual ventricular function in revascularized acute myocardial infarction, without residual lesion (gated-SPECT at rest).	I	B
To assess acute myocardial infarction with suspected **RV involvement** (RNV at rest).when the echocardiogram is not assessable	IIa	B

SPECT: Single photon emission computed tomography. RV: Right ventricular. RNV: Radionuclear ventriculography.

B. Non-ST-segment elevation acute myocardial infarction

Recommendation	Class	Level of evidence
To identify inducible ischemia and localization of culprit lesion or in remote areas in patients with acute myocardial infarction and no coronary angiography and with low or intermediate risk of major events. (exercise stress, submaximal test, or dipyridamole gated-SPECT).	I	B
In **stabilized** patients, to assess the hemodynamic significance of a **coronary lesion** diagnosed by CA of dubious severity, or in the case of multiple lesions to identify the culprit vessel (exercise stress, submaximal test, or dipyridamole SPECT or gated-SPECT).	I	B
Acute myocardial infarction with suspected **RV involvement** (resting RNV) when the echocardiogram is not assessable.	IIa	B

CA: Coronary angiography. SPECT: Single photon emission computed tomography. RV: Right ventricular. RNV: Radionuclear ventriculography.

Myocardial perfusion recommendation for risk assessment and pre-discharge prognosis

Recommendation	Class	Level of evidence
In the prognostic assessment (residual or remote ischemia) of patients with ST-segment or non-ST-segment elevation acute myocardial infarction (residual ischemia): exercise stress gated-SPECT. To assess left ventricular resting function: gated-SPECT at rest or RNV.	I	B

SPECT: Single photon emission computed tomography. RNV: Radionuclear ventriculography.

ACUTE CHEST PAIN

Assessment of acute chest pain in the Emergency Unit

A. Symptomatic patients with acute chest pain. Recommendation	Class	Level of evidence
Exercise stress gated-SPECT for low or intermediate risk populations with negative markers and non-diagnostic ECG.	I	B
Gated-SPECT at rest to assess the risk of possible ACS, with non-diagnostic markers and non-diagnostic ECG.	I	A
B. Patients with symptom remission for >12 h with negative serum markers (troponin).		
Myocardial perfusion studies with exercise/pharmacological stress gated-SPECT.	I	B

SPECT: Single photon emission computed tomography. ECG: Electrocardiogram. ACS: Acute coronary syndrome.

RISK STRATIFICATION OF PATIENTS ADMITTED TO THE CORONARY CARE UNIT WITH DIAGNOSIS OF UNSTABLE ANGINA

Myocardial perfusion with gated SPECT

Recommendation	Class	Level of evidence
Exercise stress gated-SPECT in stabilized intermediate risk patients (TIMI score 3-4; GRACE score 109-140).	I	C
Stabilized intermediate risk patients (TIMI score 3-4; GRACE score 109-140) with **conduction disorders**, complete LBBB or **unable to perform exercise**: pharmacological stress gated-SPECT.	I	B
Low risk patients (TIMI score 0-2, GRACE score <108) with no pain recurrence, negative troponin, no electrocardiographic changes: **exercise** or pharmacological gated-SPECT.	I	B
Exercise stress gated-SPECT in low risk patients **with abnormal baseline ECG**.	I	B

SPECT: Single photon emission computed tomography. RV: Right ventricular. RNV: Radionuclear ventriculography.

STABLE CHRONIC CORONARY HEART DISEASE

Risk stratification in asymptomatic patients or with stable symptoms and in patients with new symptoms or functional class worsening

A. Asymptomatic or stable symptoms with: Previous normal or abnormal myocardial perfusion studies and/or non-revascularized coronary lesions . Recommendation	Class	Level of evidence
Exercise stress gated-SPECT with more than 2-year previous studies.	I	B
Patients with non-diagnostic or positive GXT.	I	B
Prior normal exercise stress gated-SPECT with study performed less than 2 years ago.	IIb	B
Prior abnormal gated-SPECT or known coronary lesions of less than 2-year duration.	IIa	B
B. Patients with new symptoms or symptom worsening		
Exercise or pharmacological stress gated-SPECT due to the impossibility of performing exercise or presence of complete LBBB.	I	B
Patient with nonconclusive GXT and unable to perform exercise: exercise or pharmacological stress gated-SPECT.	I	B

SPECT: Single photon emission computed tomography. GXT: Graded exercise testing. LBBB: Left bundle branch block.

MYOCARDIAL REVASCULARIZATION

A. Follow-up strategies with myocardial perfusion study after revascularization in symptomatic patients

Recommendation	Class	Level of evidence
Stress images should be preferred to graded exercise testing.	I	A

B. Follow-up strategies by myocardial perfusion imaging after revascularization in asymptomatic patients.

Recommendation	Class	Level of evidence
Stress images should be preferred **on a regular basis** to graded exercise testing **≥2 years post PTCA or ≥5 years post CABG.**	IIa	A
Early **assessment with provocative ischemia** with imaging studies should be considered in a subgroup of patients: - ST-segment elevation AMI patients prior to discharge or when treated with primary PTCA or emergency CABG. - Critical professions (pilots and drivers). - Patients with incomplete or suboptimal revascularization. - Perioperative AMI. - Dissection during PTCA.	IIa	C

PTCA: Percutaneous transluminal coronary angioplasty. CABG: Coronary artery bypass grafting. AMI: Acute myocardial infarction.

CARDIOMYOPATHIES

A. Infiltrative cardiomyopathy Recommendation	Class	Level of evidence
Infiltration assessment (technetium pyrophosphate).	IIb	B
Presence of ischemia assessment.	IIb	C
Ventricular function assessment (RNV or gated-SPECT).	IIb	C
B. Chagasic cardiomyopathy		
Presence of ischemia assessment.	IIa	C
Ventricular function assessment (RNV or gated-SPECT).	IIa	C
C. Cardiotoxic cardiomyopathy (chemotherapy)		
Ventricular function assessment before and after the administration of chemotherapy cycles (anthracyclines, doxorubicin, epirubicin, etc).	IIa	A

RNV: Radionuclear ventriculography. SPECT: Single photon emission computed tomography.

DIABETES

A. Asymptomatic diabetic patients

Recommendation	Class	Level of evidence
Gated-SPECT in asymptomatic diabetic patients with any of the following conditions: Abnormal ECG (suggesting ischemia, sequel or complete LBBB). Peripheral artery disease. Patients >35 years who wish to perform sports and not suitable for GXT. Heart failure with recent LV dysfunction, without symptoms of ischemia or equivalent or previous coronary artery disease studies.	I	B
Patient with calcium score >400.	I	B
Patient with calcium score between **100 and 400**, with **clinical variables** of **unfavorable** prognosis. (microalbuminuria, retinopathy, age >65 years, duration of diabetes >10 years, nephropathy, metabolic syndrome, autonomic neuropathy, insulin requirement).	I	B

SPECT: Single photon emission computed tomography. ECG: Electrocardiogram. LBBB: Left bundle branch block. GXT: Graded exercise testing. LV: Left ventricular.

B. Symptomatic diabetic patients

Recommendation	Class	Level of evidence
Symptomatic patients (not ACS) with **suspected or known coronary artery disease**: exercise stress gated-SPECT.	I	B
Symptomatic patients with possible coronary syndrome without changes in markers or ECG.	I	A

ACS: Acute coronary syndrome. SPECT: Single photon emission computed tomography. ECG: Electrocardiogram.

CORONARY HEART DISEASE IN WOMEN

A. Asymptomatic women with suspected coronary artery disease

Recommendation	Class	Level of evidence
Women with high/intermediate pretest probability, non- interpretable ECG and not fit to perform exercise: gated-SPECT with pharmacological stress.	IIa	B
Women with high/intermediate pretest probability, interpretable ECG and fit for exercise: exercise stress gated-SPECT.	IIb	C

SPECT: Single photon emission computed tomography. ECG: Electrocardiogram.

B. Women with chest pain (typical or atypical symptoms) without evidence of coronary artery disease

Recommendation	Class	Level of evidence
Women with high/intermediate pretest probability + normal ECG + positive GXT result (or high/ intermediate risk by the Duke score).	I	B
Women with high/intermediate pretest probability + abnormal ECG and/or non-interpretable complete LBBB: gated-SPECT with pharmacological stress.	I	B

ECG: Electrocardiogram. GXT: graded exercise testing. LBBB: Left bundle branch block. SPECT: Single photon emission computed tomography.

C. Women with known coronary artery disease

Recommendation	Class	Level of evidence
For functional assessment of lesion or multiple vessel evaluation (culprit ischemic lesion): exercise gated-SPECT.	I	B

SPECT: Single photon emission computed tomography.

RECOMMENDATIONS IN HEART FAILURE AND EXPLORATION OF MYOCARDIAL VIABILITY

Recommendation	Class	Level of evidence
Heart failure assessment		
To diagnose coronary artery disease in patients with heart failure with systolic dysfunction of unknown etiology.	I	B
To assess ventricular function in case of poor quality echocardiogram.	IIa	B
Viability assessment (gated-SPECT / FDG PET)		
To define myocardial viability in patients with:		
a) CHF and severe depression of LVSF, who are candidates for revascularization or transplantation.	I	B
b) Moderate or severe fixed perfusion defects or with ambiguous results in other complementary studies.	I	B
To predict improvement of heart failure symptoms after revascularization.	IIa	B
Assessment of the extent of viable tissue to justify revascularization.	I	B

SPECT: Single photon emission computed tomography. PET: Positron emission tomography. FDG: Fluorodesoxyglucose. CHF: Congestive heart failure. LVSF: Left ventricular systolic function.

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CARDIOVASCULAR NUCLEAR MAGNETIC RESONANCE IMAGING

Coronary heart disease/ischemic cardiomyopathy

Recommendation	Class	Level of evidence
Late gadolinium enhancement to diagnose subendocardial infarctions, if the echocardiogram is not conclusive.	I	B
Late gadolinium enhancement to assess pre-revascularization myocardial viability.	IIa	B
Late gadolinium enhancement to detect silent infarction, risk stratification and prognosis.	IIa	B
Late gadolinium enhancement to detect small infarcts after revascularization procedures (myocardial revascularization surgery or coronary angioplasty).	IIa	C
Viability assessment with low dose dobutamine stress CMRI in patients with equivocal or inconclusive dobutamine stress echocardiography or SPECT.	I	B
Coronary angioresonance	III	C

CMRI: Cardiac magnetic resonance imaging. SPECT: Single-photon emission computed tomography

Acute myocardial infarction (salvaged myocardium, microvascular obstruction)

Recommendation	Class	Level of evidence
Late gadolinium enhancement in acute myocardial infarction (to assess infarct size, residual ventricular function, microvascular obstruction).	IIa	B
Detection of mechanical complications.	IIa	C

Infarction with healthy coronary arteries

Recommendation	Class	Level of evidence
Assessment in patients with positive troponin and without angiographic lesions in the coronary angiography	IIa	B

DOBUTAMINE STRESS CARDIAC MAGNETIC RESONANCE IMAGING OR PERFUSION IMAGING WITH VASODILATORS

Chronic stable angina

Recommendation	Class	Level of evidence
To assess the functional significance of known coronary heart stenosis in patients with or without exercise possibility, and interpretable or non-interpretable ECG.	IIa	B
Suspicion of coronary artery disease, exercise possibility, non-interpretable ECG.	IIa	B
Suspicion of coronary artery disease, exercise impossibility, interpretable ECG.	IIa	B
Suspicion of coronary artery disease, exercise possibility, interpretable ECG.	IIb	C

ECG: Electrocardiogram

Asymptomatic patients with suspected coronary artery disease

Recommendation	Class	Level of evidence
Intermediate pretest probability of coronary artery disease with equivocal result in another test.	IIa	C
Exercise possibility, intermediate-high probability of coronary artery disease, non-interpretable ECG.	IIa	B
Exercise impossibility, intermediate-high probability of coronary artery disease.	IIa	B
Exercise possibility, interpretable ECG.	IIb	C

ECG: Electrocardiogram

Acute chest pain

Recommendation	Class	Level of evidence
Intermediate pretest probability of coronary artery disease with non-interpretable ECG or exercise impossibility.	IIa	C
Intermediate pretest probability of coronary artery disease, ECG without changes and negative serum markers.	IIb	C
Low pretest probability of coronary artery disease with interpretable ECG and without exercise limitations.	III	C
High pretest probability of coronary artery disease, ECG with ischemic changes and/or positive enzymes.	III	C

ECG: Electrocardiogram

CARDIOMYOPATHIES

Idiopathic dilated cardiomyopathy

Recommendation	Class	Level of evidence
Volume, systolic function or ventricular mass assessment in patients with inadequate echocardiographic window or discordant results.	I	B
Volume, systolic function or ventricular mass assessment	IIa	B
Assessment of specific cause of cardiomyopathy (differential diagnoses). Late gadolinium enhancement imaging to assess presence of fibrosis and prognosis and for eventual patient selection for ICD.	IIa	B

ICD: Implantable cardioverter defibrillator

Arrhythmogenic right ventricular dysplasia

Recommendation	Class	Level of evidence
Evaluation of right ventricular volumes and regional wall motion in patients with ARVD suspicion.	I	B
Late gadolinium enhancement imaging to assess extension of right and left ventricular fibrosis in patients with ARVD suspicion.	IIa	C

ARVD: Arrhythmogenic right ventricular dysplasia

Myocarditis

Recommendation	Class	Level of evidence
Patients with clinical suspicion of myocarditis.	I	B

Non-compacted myocardium

Recommendation	Class	Level of evidence
Suspicion of non-compacted myocardium (independently of echocardiographic result)	I	C
Late gadolinium enhancement imaging to evaluate presence of fibrosis and prognosis.	IIb	C

Sarcoidosis

Recommendation	Class	Level of evidence
Evaluation of patients with clinical suspicion of sarcoidosis	I	B
Late gadolinium enhancement and edema imaging to assess presence of fibrosis and prognosis in patients with confirmed cardiac sarcoidosis.	IIb	C

Chagas disease

Recommendation	Class	Level of evidence
Evaluation of patients with clinical suspicion of Chagas disease	IIb	C

Increased ventricular mass / amyloidosis

Recommendation	Class	Level of evidence
Patient with increased myocardial mass and inconclusive echocardiogram for differential diagnosis.	I	B
Evaluation in patients with clinical suspicion of amyloidosis.	I	B

Fabry disease

Recommendation	Class	Level of evidence
Evaluation of cardiac involvement in patients with diagnosis of Fabry disease.	IIa	C

Hemochromatosis (iron overload)

Recommendation	Class	Level of evidence
Evaluation of cardiac involvement in patients with clinical suspicion of iron overload.	I	B
Monitoring of iron chelating therapy	I	B

Hypertrophic cardiomyopathy

Recommendation	Class	Level of evidence
Evaluation in patients with clinical suspicion of hypertrophic cardiomyopathy and inconclusive echocardiogram.	I	B
Arrhythmic risk stratification in patients with confirmed diagnosis.	IIa	B

HEART VALVE DISEASE

Aortic stenosis

Recommendation	Class	Level of evidence
Suspicion of bicuspid valve, not confirmed by another method.	I	B
Severity assessment, with inconclusive echocardiography.	I	B
To assess myocardial fibrosis (late gadolinium enhancement) in severe aortic stenosis.	IIb	B

Pulmonary stenosis or regurgitation

Recommendation	Class	Level of evidence
To assess severity, valve morphology, right ventricular volumes, mass and function and pulmonary vasculature in moderate/severe pulmonary valve disease.	I	B

Left heart valve regurgitation

Recommendation	Class	Level of evidence
Assessment of ventricular volumes and function and regurgitation severity in patients with inconclusive echocardiography.	I	B
Assessment of ventricular volumes and function and regurgitation severity in patients with conclusive echocardiography	IIb	B

Mitral stenosis

Recommendation	Class	Level of evidence
Severity assessment in patients with inconclusive echocardiography.	I	B
Assessment of right ventricular volumes, function and mass in patients with significant pulmonary hypertension.	IIb	C

Tricuspid valve disease

Recommendation	Class	Level of evidence
Severity assessment in patients with inconclusive echocardiography.	I	B

PERICARDIAL DISEASES

Pericardium

Recommendation	Class	Level of evidence
Assessment of known or suspected constrictive pericarditis.	I	B
Suspicion of acute pericarditis.	IIa	C
Quantification and characterization of pericardial effusion.	IIb	C
Assessment of pericardial calcification.	III	C

CARDIAC TUMORS AND MASSES

Cardiac masses

Recommendation	Class	Level of evidence
Evaluation of cardiac mass with non-diagnostic echocardiogram.	I	B
Tissue characterization and extension to neighboring structures.	I	B
Evaluation of cardiac mass with diagnostic echocardiogram.	IIa	C

CONTRIBUTION OF CARDIAC MAGNETIC RESONANCE IMAGING IN PATIENTS WITH FREQUENT VENTRICULAR ARRHYTHMIA

Frequent ventricular arrhythmia

Recommendation	Class	Level of evidence
To assess structural heart disease in patients with normal echocardiogram.	IIa	C
To complement assessment of known structural heart disease.	IIb	C

THORACIC AORTIC DISEASE

Acute aortic disease

Recommendation	Class	Level of evidence
Diagnosis of aortic intramural hematoma.	I	B
Diagnosis of aortic penetrating atherosclerotic ulcer.	I	B
Diagnosis of acute dissection in hemodynamically stable patients.	IIa	B
Diagnosis of acute aortic dissection in hemodynamically stable patients with inconclusive or contraindicated TEE/CT scan.	I	B
Diagnosis of acute aortic dissection in hemodynamically stable patients requiring differential PTE or ACS diagnosis.	III	B

TEE: Transesophageal echocardiography. CT: Computed tomography. PTE: Pulmonary theromboembolism. ACS: Acute coronary syndrome.

Acquired chronic aortic disease

Recommendation	Class	Level of evidence
Diagnosis and follow-up of aortic aneurysm.	I	B
Diagnosis and follow-up of aortic dilatation not assessable by echocardiography.	I	B
Diagnosis and follow-up of aortic dilatation in addition to assessment of aortic valve disease and left ventricular hemodynamic impact, not assessable by echocardiography.	I	B
Diagnosis and follow-up of chronic aortic dissection.	I	B

PULMONARY HYPERTENSION

Recommendation	Class	Level of evidence
Assessment of right ventricular volumes, function and mass in patients with pulmonary hypertension.	I	B
Estimation of the degree of severity in patients with inconclusive echocardiogram.	IIb	C

CONTRIBUTIONS IN CONGENITAL HEART DISEASE

Diagnosis

Recommendation	Class	Level of evidence
To establish diagnosis of simple and complex heart diseases, especially in cases with persisting doubt after echocardiographic evaluation or prior to cardiac catheterization.	I	B

Evaluation of the right ventricle

Recommendation	Class	Level of evidence
To evaluate the right ventricle, especially in heart defects such as tetralogy of Fallot, pulmonary atresia, ventricular septal defect, Ebstein's anomaly, double-chambered right ventricle, congenitally corrected transposition of the great vessels (CCTGV) and in patients with transposition of the great vessels (TGV) undergoing atrial switch surgery (Senning or Mustard procedure).	I	B
To assess venous and systemic channel patency or obstruction in patients with atrial switch procedure.	I	B

Short circuits

Recommendation	Class	Level of evidence
To diagnose defects of the type sinus venosus atrial septal defect and those associated with pulmonary venous return anomalies (isolated or associated to atrial septal defect).	I	B
To diagnose atrial membranes such as cor triatriatum.	I	B
To diagnose the scimitar syndrome (anomalous drainage of the pulmonary vein into the inferior vena cava): it assesses the anomalous venous collector, right pulmonary artery abnormalities and lung hypoplasia.	I	C
To diagnose ostium secundum or ostium primum atrial septal defect.	IIa	B
To calculate shortcircuit (Qp/Qs) from the analysis of systemic and pulmonary arterial flow.	I	B
In patients operated on with anomalous pulmonary venous return or systemic venous return correction.	I	B
In cases of ventricular septal defect associated with complex anomalies, MRI provides anatomical information.	I	B
To diagnose persistent ductus arteriosus or aorto-pulmonary window in patients with difficult ultrasound window.	I	B
In isolated ventricular septal defects, it allows defining defect anatomy, localization, and valve relationship, though echocardiographic information is considered critical.	IIb	B
In persistent ductus arteriosus it allows assessing size and anatomical type. However, the technique may give rise to false negatives if sections are not sufficiently thin.	IIb	C

MRI: Magnetic resonance imaging

Heart valve disease

Recommendation	Class	Level of evidence
To diagnose bicuspid aortic valve with non-diagnostic echocardiography: it defines annulus and aortic root anatomy and dimensions, presence of aneurysm in any of the aortic sinuses and assesses valve function.	I	B
To assess pulmonary regurgitation, as in repaired tretalogy of Fallot, idiopathic pulmonary artery dilatation, pulmonary valve agenesis and in patients with surgical treatment of pulmonary valve stenosis (prior to the possibility of balloon valvuloplasty).	I	B
To assess tricuspid regurgitation in Ebstein's anomaly or congenital tricuspid regurgitation.	IIb	B

Subpulmonary ventricular defects

Recommendation	Class	Level of evidence
To assess ejection fraction, ventricular volumes and conduit patency in patients with subpulmonary ventricular septal defects.	I	C

ARTERIAL BLOOD VESSELS: AORTA, NECK BLOOD VESSELS AND PULMONARY BRANCHES

Thoracic aorta

Recommendation	Class	Level of evidence
To assess the thoracic aorta in patients with diagnosis or suspicion of aortic coarctation with or without gradient assessment, or postoperative follow-up and/or vascular annulus diagnosis.	I	B

Single ventricle

Recommendation	Class	Level of evidence
To assess ejection fraction, ventricular volume and after-palliative interventions in patients with single ventricle physiology, independently of the variant.	I	B

ADVANTAGES AND DISADVANTAGES OF CARDIAC MAGNETIC RESONANCE IMAGING COMPARED WITH OTHER METHODS IN PATIENTS WITH CONGENITAL HEART DISEASES

Pericardium

Advantages	Disadvantages
Visualization of anatomical structures (precise definition)	1-15% of patients with claustrophobia
Non-invasive method	High cost/device availability
Radiation free	Experienced operator
Reproducible	Limited use in patients with stents, occluding devices, intrathoracic wires, vertebral column bars.
Kinetic images allow myocardial, valve and blood flow assessment.	Unsafe/not recommended in: - patients carrying pacemakers/cardioverter defibrillators/ resynchronization devices - patients with implanted electric, cochlear or hearing devices. - Starr Edwards type cardiac valve prosthesis
Magnetic resonance angiography allows pulmonary and pulmonary branch flow, systemic flow and arterial collateral flow assessment.	Prolonged study (average duration: 30 to 40 min)

USEFULNESS OF EACH METHOD IN THE ASSESSMENT OF DIFFERENT STRUCTURES

(++++ greatest usefulness / + lowest usefulness)

Recommendation	Echocardiogram	CMRI	CT
Heart valve disease	++++	+++	+
Septal defects	++++	+++	+
Coronary arteries	+	+++	++++
Thoracic aorta	++	++++	++++
Pulmonary arteries and veins	+	+++	++++
Shunt quantification	++	++++	+
Pulmonary pressure quantification	+++	+	+
Myocardial perfusión/viability	+++	++++	++
Ventricular volumes and EF	+++	++++	++

CMRI: Cardiac magnetic resonance imaging. CT: Computed tomography. EF: Ejection fraction.

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CARDIAC COMPUTED TOMOGRAPHY

A. CARDIAC COMPUTED TOMOGRAPHY IN THE ACUTE PATIENT

Coronary artery anatomy assessment by cardiac computed tomography in patients with acute chest pain

Recommendation	Class	Level of evidence
Noninvasive assessment of the coronary tree in patients with chest pain and low to intermediate probability of coronary artery disease, negative window biomarkers and normal electrocardiogram.	IIa	A
In patients with high probability of coronary artery disease and/or electrocardiographic abnormal ST-segment changes and elevated enzymatic levels.	III	A

B. CARDIAC COMPUTED TOMOGRAPHY IN THE NON-ACUTE PATIENT

Evaluation of patients with previous functional studies for coronary artery anatomy assessment

Recommendation	Class	Level of evidence
Discordant myocardial stress imaging studies.	I	B
Prior normal exercise stress test with symptom persistence.	IIa	B
New symptoms or symptom progression with prior negative myocardial stress imaging study.	IIa	B
Mild ischemia in myocardial stress imaging study	IIb	B
Moderate to severe ischemia in myocardial stress imaging study	III	B

Cardiac computed tomography angiography in non-acute symptomatic patients for coronary artery anatomy assessment

Recommendation	Class	Level of evidence
Non-assessable ECG or impossibility of exercise performance with intermediate pre-test probability of coronary artery disease.	IIb	B
Assessable ECG and possibility of exercise performance with intermediate pre-test probability of coronary artery disease.	IIb	B

Cardiac computed tomography angiography in asymptomatic patients for coronary artery anatomy assessment

Recommendation	Class	Level of evidence
Risk stratification in asymptomatic patients without history of coronary artery disease.	III	A

Cardiac computed tomography angiography for preoperative cardiac surgery assessment

Recommendation	Class	Level of evidence
Coronary artery assessment prior to cardiac surgery in patients with low pre-test probability of coronary artery disease.	IIa	C

C. STENT AND CORONARY BRIDGE PATENCY ASSESSMENT

Computed tomography angiography for stent and coronary bridge patency assessment

Recommendation	Class	Level of evidence
To assess coronary bridge patency in patients with history of CABG.	IIa	B
To assess stent patency in asymptomatic patients with history of left main coronary artery PCI.	IIa	B
To assess stent permeability in patients with history of PCI with stent ≥3 mm.	IIb	B
In patients with history of PCI with stent <3 mm or of unknown caliber.	III	B
In patients with history of CABG and positive functional tests.	III	B

D. CORONARY CALCIUM SCORE

Table 1. Agatston score

Calcium score	Implications	Risk of coronary artery disease
0	Non-identifiable plaque	Very low, generally below 5%
1 -10	Minimum identifiable plaque	Low probability, less than 10%
11 - 100	Definitive plaque, at least mild atherosclerotic plaque	Mínimum or mild coronary stenosis
101 - 400	Definitive plaque, at least moderate atherosclerotic plaque	Mild to moderate coronary stenosis
401 or more	Extensive and severe atherosclerotic disease	High probability of at least one significant coronary stenosis

Calcium score for asymptomatic patients

Recommendation	Class	Level of evidence
To reclassify patients of intermediate clinical risk by the Framingham score (10-20% risk at 10 years)	IIa	A
To reclassify patients of low clinical risk by the Framingham score (risk below 10% at 10 years)	IIb	B
To reclassify patients of high clinical risk by the Framingham score (risk above 20% at 10 years)	III	B

Calcium score for symptomatic patients

Recommendation	Class	Level of evidence
Symptomatic patients with equivocal or inconclusive functional tests.	IIb	B
As a tool for risk assessment in symptomatic patients with negative ECG and cardiac enzymes.	IIb	B
Follow-up by calcium score progression.	III	B

ECG: Electrocardiogram.

E. USEFULNESS OF MULTIDETECTOR COMPUTED TOMOGRAPHY ANGIOGRAPHY IN CHRONIC AORTIC DISEASE

Calcium score for symptomatic patients

Recommendation	Class	Level of evidence
To define conducts in patients carrying genetic syndromes with risk of aortic involvement.	I	C
To study presence of atheromatous plaque type and extension, as well as the presence of hematomas or chronic dissection.	I	C
Follow-up of patients with asymptomatic aortic aneurysm, chronic type-B dissections and postoperative control.	IIa	C
To diagnose thoracic and abdominal aortic disease, as well as the extension, severity and involvement of visceral branches.	I	B
To diagnose and follow-up complications of aortic endoprostheses.	I	C

F. ACUTE AORTIC SYNDROMES

Aortic computed tomography angiography

Recommendation	Class	Level of evidence
Patient with suspected acute aortic syndrome.	I	A
Patient with suspected acute aortic syndrome and hemodynamic instability.	III	C

G. PULMONARY THROMBOEMBOLISM

Pulmonary artery computed tomography angiography

Recommendation	Class	Level of evidence
Pulmonary artery computed tomography to diagnose acute or chronic pulmonary thromboembolism	I	A

H. TRIPLE RULE OUT

Table 2. Ideal patient selection for triple rule out

Clinical presentation: Low to moderate risk of ACS
Clinical presentation: Possibility of non-coronary syndrome
Negative biomarkers (troponin I, myoglobin)
Normal ECG or with non-specific changes
With no history suggesting extensive calcific coronary artery disease.
Not recommended in known coronary artery disease, stents or coronary bypass surgery.
Patients not allergic to iodine, with good renal function
Patients with acceptable rhythm for gated study, tolerating a necessary apnea

ACS: Acute coronary syndrome. ECG: Electrocardiogram

Triple Rule Out

Recommendation	Class	Level of evidence
To rule out the presence of acute coronary syndrome and other non-coronary causes of chest pain, such as pulmonary thromboembolism and acute aortic syndrome in patients presenting at the emergency department with acute chest pain (electrocardiogram and inconclusive biomarkers), and low to intermediate risk of coronary artery disease.	IIb	C

I. TAVI. ASSESSMENT STRATEGIES. TECHNICAL FEASIBILITY

Pre-implant cardiac computed tomography in patients undergoing transcatheter aortic valve implantation

Recommendation	Class	Level of evidence
Gated contrast-enhanced computed tomography to assess aortic annulus, thoraco-abdominal aorta and peripheral vascular accesses in patients undergoing evaluation for transcatheter aortic valve implantation.	I	C

J. CARDIAC COMPUTED TOMOGRAPHY ANGIOGRAPHY IN AORTIC STENOSIS

Aortic valve calcium score

Recommendation	Class	Level of evidence
As complementary information in aortic valve stenosis in patients with discordant clinical-echocardiographic evidence.	IIa	B
In the assessment of patients with aortic stenosis and depressed ventricular function (low gradient with small area) to complement dobutamine stress echocardiography.	IIa	C
As complementary information in aortic valve stenosis in patients with poor echocardiographic window.	IIb	C

K. CONGENITAL HEART DISEASE IN ADULTS

Cardiac and extra-cardiac morphological assessment

Recommendation	Class	Level of evidence
In patients who will undergo surgical reintervention, it is recommended for better surgical approach,•to define situs anatomy, determine cardiosternal distance and the position of cardiac structures in relation with the thorax.	I	C

Circulation

Recommendation	Class	Level of evidence
To assess arterial anatomy in patients with coarctation of the aorta and/or to evaluate systemic-pulmonary collaterals, frequent in pulmonary atresia and cyanotic diseases.	I	B
To assess venous anatomy in cyanotic diseases and/or cardiac and pulmonary arteriovenous malformations.	I	B
To assess partial and complete pulmonary venous return anomalies.	I	B

L. CARDIAC TUMORS AND PSEUDOTUMORS

Cardiac computed tomography to assess cardiac tumors and pseudotumors

Recommendation	Class	Level of evidence
To assess cardiac masses in patients with bad ultrasound window and impossibility of performing CMRI.	IIa	C

CMRI: Cardiac magnetic resonance imaging.

M. PERICARDIUM

Use of computed tomography to assess the pericardium

Recommendation	Class	Level of evidence
To assess pericardial calcification prior to pericardiectomy.	I	C
To assess the pericardium.	IIa	C

N. MULTIDETECTOR COMPUTED TOMOGRAPHY PULMONARY VEIN ASSESSMENT FOR ATRIAL FIBRILLATION ABLATION

Recommendation	Class	Level of evidence
Pulmonary vein assessment for atrial fibrillation ablation.	I	C

O. CORONARY VEIN COMPUTED TOMOGRAPHYABLATION

Recommendation	Class	Level of evidence
To study coronary venous anatomy prior to implantation of resynchronization pacemaker.	IIb	C

P. CORONARY ANOMALIES

Computed tomography in case of suspected coronary artery anomalies

Recommendation	Class	Level of evidence
Patients with suspicion or for preoperative evaluation of coronary artery anomalies.	I	B

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