Regence

Medical Policy Manual Medicine, Policy No. 168

Myocardial Strain Imaging

Effective: April 1, 2024

Next Review: December 2024
Last Review: March 2024

IMPORTANT REMINDER

Medical Policies are developed to provide guidance for members and providers regarding coverage in accordance with contract terms. Benefit determinations are based in all cases on the applicable contract language. To the extent there may be any conflict between the Medical Policy and contract language, the contract language takes precedence.

PLEASE NOTE: Contracts exclude from coverage, among other things, services or procedures that are considered investigational or cosmetic. Providers may bill members for services or procedures that are considered investigational or cosmetic. Providers are encouraged to inform members before rendering such services that the members are likely to be financially responsible for the cost of these services.

DESCRIPTION

Myocardial strain refers to the deformation (shortening, lengthening, or thickening) of the myocardium through the cardiac cycle. Myocardial strain can be measured by tissue Doppler imaging or, more recently, speckle-tracking echocardiography. Speckle-tracking echocardiography uses imaging software to assess the movement of specific markers in the myocardium that are detected in standard echocardiograms. It is proposed that a reduction in myocardial strain may indicate sub-clinical impairment of the heart and can be used to inform treatment before development of symptoms and irreversible myocardial dysfunction.

MEDICAL POLICY CRITERIA

Myocardial strain imaging is considered **investigational** for all indications.

NOTE: A summary of the supporting rationale for the policy criteria is at the end of the policy.

CROSS REFERENCES

None

BACKGROUND

The term strain indicates dimensional or deformational change under force. When used in echocardiography, the term ‘strain’ is used to describe the magnitude of shortening, thickening and lengthening of the myocardium through the cardiac cycle. The most frequent measure of myocardial strain is the deformation of the left ventricle (LV) in the long axis, termed global longitudinal strain (GLS). Strain is a dimensionless measure of tissue deformation (L – L0)/L0, where L is final length and L0 the original length; positive values indicate lengthening, and negative values indicate shortening.[1] During systole, ventricular myocardial fibers shorten with movement from the base to the apex. GLS is used as a measure of global LV function, and provides a quantitative myocardial deformation analysis of each LV segment. Myocardial strain imaging is intended to detect subclinical changes in left ventricle function in patients with a preserved LV ejection fraction (LVEF), allowing for early detection of systolic dysfunction. Since strain imaging can identify LV dysfunction earlier than standard methods, this raises the possibility of heart failure prophylaxis and primary prevention before the patient develops symptoms and irreversible myocardial dysfunction. Potential applications of speckle-tracking echocardiography (STE) are coronary artery disease, ischemic cardiomyopathy, valvular heart disease, dilated cardiomyopathy, hypertrophic cardiomyopathies, stress cardiomyopathy, and chemotherapy-related cardiotoxicity.

MYOCARDIAL STRAIN IMAGING

Myocardial strain can be measured by either tissue Doppler imaging or by speckle-tracking echocardiography (STE). Tissue Doppler strain imaging has been in use since the 1990's but has limitations that include angle dependency and significant noise. Smiseth (2016) reported that the most widely used method of measuring myocardial strain at the present time is STE.[2] In STE, natural acoustic markers generated by the interaction between the ultrasound beam and myocardial fibers form interference patterns (speckles). These markers are stable, and STE analyzes the spatial dislocation (tracking) of each point (speckle) on routine 2-dimensional sonograms. Echocardiograms are processed using specific acoustic-tracking software on dedicated workstations, with offline semiautomated analysis of myocardial strain. The 2-dimentional displacement is identified by a search with image processing algorithms for similar patterns across two frames. When tracked frame-to-frame, the spatiotemporal displacement of the speckles provides information about myocardial deformation across the cardiac cycle. GLS provides a quantitative analysis of each LV segment, which is expressed as a percentage. In addition to GLS, STE allows evaluation of LV rotational and torsional dynamics.

REGULATORY STATUS

A number of image analysis systems have been cleared for marketing by the U.S. Food and Drug Administration (FDA) through the 510(k) process. Examples of these are shown in Table 1.

Table 1. FDA Clearances

Brand Name	Manufacturer	510(k) Number	FDA Product Code	Clearance Date
Myostrain	Myocardial Solutions	K182756	LNH	02/14/2019
2D CARDIAC PERFORMANCE ANALYSIS	Tomtec	K120135	LLZ	04/13/2012
EcholnsIght	Epsilon Imaging	K110447	LLZ	05/27/2011
Q-lab	Phillips	K023877	LLZ	12/23/2002

Brand Name	Manufacturer	510(k) Number	FDA Product Code	Clearance Date
Vivid	GE	K181685	IYN	10/25/2018
Aplio	Toshiba		IYN	01/11/2018

FDA: Food and Drug Administration.

EVIDENCE SUMMARY

Evidence reviews assess whether a medical test is clinically useful. A useful test provides information to make a clinical management decision that improves the net health outcome. That is, the balance of benefits and harms is better when the test is used to manage the condition than when another test or no test is used to manage the condition.

The first step in assessing a medical test is to formulate the clinical context and purpose of the test. The test must be technically reliable, clinically valid, and clinically useful for that purpose. Evidence reviews assess the evidence on whether a test is clinically valid and clinically useful. Technical reliability is outside the scope of these reviews, and credible information on technical reliability is available from other sources.

MYOCARDIAL STRAIN IMAGING TO DETECT CARDIOTOXICITY IN ADULTS

Clinical Validity

A systematic review published by McGregor in 2020 assessed the literature on myocardial strain imaging for detection of cardiotoxicity from chemotherapy in cancer patients. A total of 31 studies were identified. Of these, only two reported hard clinical endpoints such as cardiac events and development of clinical heart failure. No assessment of study quality or meta-analysis was reported. There was some overlap with the 2014 systematic review discussed below, but most studies were published more recently than that systematic review's search dates. The majority of included studies assessed patients with breast cancer, while some included hematologic malignancies, and three included patients with sarcoma. Overall, the review concluded that myocardial strain imaging has benefits, such as helping to overcome limitations of LVEF assessment adding reliability to diagnosis and prognostication regarding subclinical cardiotoxicity, but also limitations, such as variations in strain values based on loading conditions and patient-related factors.

Thavendiranathan (2014) conducted a systematic review of myocardial strain imaging for the early detection of cardiotoxicity in patients during and after cancer chemotherapy.[3] Searches were conducted through November 2013. The reviewers included prospective or retrospective studies of at least ten patients that used echocardiographic-based myocardial deformation parameters as the primary method to detect cardiotoxicity. Studies had to provide data on changes in deformation parameters and LVEF during therapy. The authors focused the review on three clinical scenarios: 1) detection of early myocardial changes; 2) prediction of subsequent cardiotoxicity; and 3) detection of late consequences of therapy (>1 year posttreatment).

Detection of early myocardial changes: Thirteen single-center cohort studies (n=384) provided information on MSI parameters to detect early myocardial changes in patients treated with anthracycline-containing regimens. The earlier studies (n=7) used tissue Doppler imaging while more recent studies (n=6) used STE. There was heterogeneity regarding patient age, types of cancer, strain techniques, and timing of follow-up but all of the studies found that

changes in myocardial deformation occurred earlier than changes in LVEF. In addition, reductions in myocardial deformation occurred at doses lower than those historically considered cardiotoxic.

Prognosis for early cardiotoxicity: Eight observational studies (n=452) included in the systematic review evaluated the prognostic value of MSI for subsequent cardiotoxicity (LVEF reduction or the development of heart failure). The studies differed in duration of follow-up (6 months, 12 to 15 months), treatment regimens, and other factors but used a similar definition of cardiotoxicity. The researchers found that an early fall in global longitudinal strain of 10% to 15% using STE predicted subsequent cardiotoxicity.

Prognosis for late cardiotoxicity: Nine case-control studies (n=436) were identified that compared findings in patients to controls. All of the studies used various myocardial deformation parameters to detect late subclinical cardiac injury, but none provided data on subsequent cardiac events.

The authors identified the following areas for future research:

- Determination of whether strain-based approaches could be reliably implemented in multiple centers, including nonacademic settings,
- Study in larger multicenter studies and in cancers other than breast cancer
- Need to determine the optimum sampling (single or multiple)
- Comparison with a traditional LVEF-based approach
- Understanding the long-term effect of strain changes that occur during therapy
- The use of vendor-neutral methods to measure strain
- The prognostic significance of strain abnormalities in survivors of cancer and those receiving radiation therapy
- Whether intervention would change the natural course of the cardiac disease.

Section Summary: Clinical Validity

A systematic review of 13 studies with 384 patients treated for cancer suggests that MSI with tissue Doppler imaging or STE may be able to identify changes in myocardial deformation that precede changes in LVEF. Although MSI may detect sub-clinical myocardial changes, the value of these changes in predicting clinical outcomes or guiding therapy is uncertain. No studies were identified that compared MSI to LVEF.

Clinical utility

Direct evidence of clinical utility is provided by studies that have compared health outcomes for patients managed with and without the test. Because these are intervention studies, the preferred evidence would be from randomized controlled trials.

The Strain Surveillance of Chemotherapy for Improving Cardiovascular Outcomes (SUCCOUR) trial, currently in progress, is the first randomized controlled trial of MSI and will provide evidence to inform guidelines regarding the place of MSI for surveillance for cardiotoxicity related to cancer chemotherapy. Preliminary descriptive results on the first 86 patients have been published, as well as one-year trial results of the trial.[4, 5] In this trial, anthracycline-treated patients with another heart failure risk factor (n=331) were randomly assigned to begin cardioprotective therapy (CPT) guided by either ≥12% relative reduction in global longitudinal strain (GLS; n=166) or >10% absolute reduction of LVEF (n=165). LVEF

was not significantly different between groups at one-year follow-up. The difference in proportion of patients with a new diagnosis at one year of LVEF <55% was also not significantly different between groups (21% vs. 22%; p=0.89). There was significantly greater use of cardioprotective therapy in the GLS group and significantly fewer patients in the GLS group met cancer therapy-related cardiac dysfunction (CTRCD) criteria (5.8% vs. 13.7%; p=0.02) at one year. However, this outcome was not prespecified, and it was defined differently for the different groups (LVEF-based in the LVEF group and GLS-based in the GLS group). An additional limitation of this study is that it was not blinded. Evidence is insufficient to determine the clinical validity of MSI.

Summary of Evidence

For individuals who have an indication for a transthoracic echocardiogram who receive MSI, the evidence includes a systematic review of observational studies. The relevant outcomes include symptoms, morbid events, quality of life, treatment-related mortality, and treatment-related morbidity. A systematic review of 13 studies with 384 patients treated for cancer suggests that MSI with tissue Doppler imaging or STE may be able to identify changes in myocardial deformation that precede changes in LVEF. Although MSI may detect sub-clinical myocardial changes, the value of these changes in predicting clinical outcomes or guiding therapy is uncertain. No studies were identified that compared MSI to LVEF. The evidence is insufficient to determine the effects of the technology on health outcomes.

MYOCARDIAL STRAIN IMAGING FOR OTHER INDICATIONS

Myocardial strain imaging has been examined for its potential use for other indications, including acute coronary syndrome, heart transplant rejection, and cardiotoxicity following treatment for cancer in childhood. The evidence for these indications is limited to observational studies.

PRACTICE GUIDELINE SUMMARY

AMERICAN COLLEGE OF CARDIOLOGY

The American College of Cardiology (ACC), American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Hearth Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, Society for Cardiovascular Magnetic Resonance, and the Society of Thoracic Surgeons (2019) published appropriate use criteria for multimodality imaging in the assessment of cardiac structure and function in nonvalvular heart disease.[6]

Using a modified Delphi approach, the panel rated indications as “appropriate”, “may be appropriate”, and “not appropriate”. The specific studies that formed the basis of the ACC guidelines are not cited, however, they note that they used ACC/American Heart Association clinical practice guidelines whenever possible.

Of 81 indications considered for strain rate imaging, the panel rated only four as “appropriate”. Three of the four concerned evaluation (initial or follow-up) in patients prior to and following exposure to potentially cardiotoxic agents. The other indication was follow-up testing to clarify initial diagnostic testing for patients with suspected hypertrophic cardiomyopathy. The guidelines did not separate out imaging with speckle tracking and tissue Doppler, and did not make recommendations related to the comparative effectiveness of these imaging modalities.

The panel rated 14 other indications as “may be appropriate”. According to the panel, interventions in this category should be performed depending on individual clinical patient circumstances and patient and provider preferences, including shared decision making.

AMERICAN SOCIETY OF CLINICAL ONCOLOGY

The American Society of Clinical Oncology clinical practice guidelines (2017) noted that measurement of strain has been demonstrated to have some diagnostic and prognostic use in patients with cancer receiving cardiotoxic therapies but that there have been no studies demonstrating that early intervention based on changes in strain alone can result in changes in risk and improved outcomes.[7] The American Society of Clinical Oncology also notes that screening for asymptomatic cardiac dysfunction using advanced imaging could lead to added distress in cancer survivors.

SUMMARY

There is not enough research to show that myocardial strain imaging improves health outcomes for any indication. Clinical guidelines based on research also note the limited evidence on the use of myocardial strain imaging. Therefore, myocardial strain imaging is considered investigational for all indications.

REFERENCES

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CODES

Codes	Number	Description
CPT	93356	Myocardial strain imaging using speckle tracking-derived assessment of myocardial mechanics (List separately in addition to codes for echocardiography imaging)
HCPCS	C9762	Cardiac magnetic resonance imaging for morphology and function, quantification of segmental dysfunction; with strain imaging
	C9763	;with stress imaging

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