From early to late ventricular remodeling after myocardial infarction: the role of echocardiographic assessment in surgical decisions

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ABSTRACT

Left ventricular (LV) remodeling following a myocardial infarction (MI) is a pathologically process of change in size, shape and volumes, wall thickness and function of the heart. Remodeling changes begin in the acute period of MI and tend to continue long after that, leading to LV dysfunction and severe heart failure in late phases. Therefore, early diagnosis of the LV remodeling is of a major importance, both for assessing the cardiovascular prognostic and for deciding the optimal management of the patients with cardiac dilatation. In the last decade, we have witnessed an extraordinary development of imaging techniques, which are able to make an accurate diagnosis of LV remodeling. Echocardiography is a rapid, feasible and simple non-invasive imagistic method, and thus represents the preferred imagistic tool for quantify the cardiac dilatation and its functional consequences. Medical treatment has been found to be ineffective for decrease the cardiac remodeling following a MI. In such cases, complex surgical procedure – coronary revascularization, ventricular restoration and mitral valve repair – represent the preferred therapeutically options. These facts require a close collaboration between the echocardiographer and the surgeon to improve the outcome of patients who have ischemic cardiac remodeling.

Key words: LV remodeling; heart failure; echocardiography; coronary revascularization; LV restoration; mitral valve repair
FROM EARLY TO LATE VENTRICULAR REMODELING AFTER MYOCARDIAL INFARCTION

1. INTRODUCTION

Ischemic heart disease (IHD) is still one of the most progressive and prognostically unfavorable disease, thus continues to represent a major public health issue. Ischemic cardiomiopathy (ICMP), a late complication of an acute myocardial infarction (MI), manifested in left ventricular (LV) remodeling and heart failure develops in 10 – 35% of the patients with IHD (1). LV remodeling is a complex pathological process that includes a combination of changes in cardiac shape and cavity volumes following a MI. Remodeling changes begin in the acute period of MI and tend to continue long after that, leading to LV dysfunction and severe heart failure in late phases (2). Even in the presence of the thrombolisis and PTCA options, that may save lives during an acute phase of MI, and of the large category of anti-remodeling drugs, still remains a proportion of incomplete myocardial reperfusion results in LV remodeling and dysfunction. In such cases, a complex surgical treatment – coronary artery by-pass grafting (CABG), restoration of LV shape and volume and mitral valve repair – represent the preferred therapeutically options. Therefore, the detection of the early or late LV remodeling changes is essential for choosing the correct surgical management of patients with ischemic heart failure. Imaging techniques play a vital role in patients with postinfarct heart remodeling, not only in diagnosis, but also in determining prognosis and deciding cardiac surgery indications.

Echocardiography is still the preferred imaging method to quantify the LV remodeling and its functional consequences. The established 2D and M-mode echocardiographic assessment of the structural and functional changes in ischemic LV remodeling, are now supplemented by the new ultrasounds methods, such as 3D evaluation, tissue Doppler and strain rate imaging or intraoperative echocardiography. In the same time, surgery of the remodeling and dysfunctional heart is also evolving a rapid development. These facts are challenging both for the echocardiographer and the surgeon and require a close collaboration between the two disciplines to improve the outcome of patients who have ischemic cardiac remodeling.

This article discuss the relationship between the early postinfarct LV remodeling and the progression to heart failure and also the usefulness and indications for the different echocardiographic techniques used in surgical management of the patients with LV remodeling. We will focus on the following aspects: 1) Progression from early to late LV remodeling after an AMI; 2) Echocardiography – a diagnostic, prognostic and therapeutically tool in surgical decision of the LV remodeling; 3) Surgical options for the LV remodeling.

II. PROGRESSION FROM EARLY TO LATE LEFT VENTRICULAR REMODELING AFTER AN ACUTE MYOCARDIAL INFARCTION

Cardiac remodeling following a MI is a pathologically process of change in size, shape and volumes, wall thickness and function due to molecular, cellular and interstitial changes (2). Cardiac remodeling represents an adverse sign and may progress to severe heart failure (3). Furthermore, this process has an important prognostic significance for the cardiovascular morbidity and mortality (4).

Cardiac remodeling occuring after a MI is well recognized. In 1935, Tennant and Wiggers were made the first observation about the changes of the structural and functional cardiac parameters following coronary arterial occlusion (5). The ventricular dilatation, the most pronounced characteristic of the cardiac remodeling occurs in 30-50% of MI cases (6). The LV remodeling may develop early, within the first hours after an infarct or late, within six months, or continues to progress from the onset of infarction, as shown in the figure 1 (2,7).

The changes that occur early within the several hours after the MI define the infarct expansion, which represents a wall thinning and

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**FIGURE 1.** Progression of LV remodeling from early to late remodeling after acute myocardial infarction
CMR: chronic mitral regurgitation; ICMP: ischemic cardiomiopathy; LV: left ventricle
elongation (figure 1). There are several mechanisms involving in this early alteration of the cardiac structure: a) activation of the inflammatory reaction related to ischemia; b) release of the metalloproteinases and other proteolytic enzymes; c) destruction of the collagen supporting tissue; d) slippage of the myocardial cells; e) stretching of the cardiomyocytes (8). Early LV remodeling is clinically represented by: early aneurysm (thinning and bulging of the myocardial wall) and the acute mechanical complications. These complications, which include myocardial rupture of the left ventricular free wall, rupture of the ventricular septum, and rupture of the papillary muscle with an acute mitral regurgitation (AMR), along with the cardiogenic shock represent now the majority causes of in-hospital death (9).

Multiple factors contribute to cardiac remodeling after a myocardial infarction. Clinical studies showed that the infarct size in the acute period of a MI is the most powerful predictor for changes in volume and function in the year after MI (10). Furthermore, the relation between infarct size and mortality is well defined: for the size of myocardial infarction or scar > 23% of the heart, the three years mortality is 43%, meanwhile for the size of myocardial infarction < 23% the mortality is 5% (p=0.014) (11). Other factors, such as transmural anterior infarct, high level of biological markers of cardiac necrosis, late revascularization, and more severe adjacent coronary lesions, have also an important impact on the further cardiac remodeling.

The early infarct expansion is initially associated with maintained cardiac output, but with significantly increased of LV volumes. On the other hand, the non-infarcted myocardial segments develop adaptive mechanisms, such as cardiac hypertrophy, in order to maintain cardiac output (figure 2) (12). This hypertrophy is initiated by mechanically stimuli, stretch and by released of humoral factors, like norepinephrine, endoteline or growth factors. If cardiac dilatation persist and compensatory hypertrophy is exhausted, the shape of the ventricle changes from ellipsoid to spherical, and, as a consequence, according to the Laplace’s low, wall stress increases, as shown in figure 3. Secondary to the altered LV geometry, annular dilatation or papillary muscle dysfunction, mitral regurgitation may occur and aggravate the LV remodeling (figure 4). Without an optimal treatment to reduce LV remodeling

![FIGURE 2. Physiopathological mechanisms of heart failure related to ischemic LV remodeling (modified from 12)](image)

CO: cardiac output; LVEDV: left ventricular end diastolic volume; LVEDP: left ventricular end diastolic pressure.
and decrease the wall stress, late LV remodeling progress to overt heart failure (figure 2) (12). This type of remodeling is clinically represented by late mechanical complications: LV aneurysm, ICMP and chronic mitral regurgitation (CMR). It has been demonstrated that in patients with ICMP, mortality untreated is directly correlated to the severity of the systolic dysfunction. Furthermore, increased of LV volumes and chamber sphericity and the presence of the mitral regurgitation are markers of worse prognosis (one year mortality untreated is 54-70%) (14).

III. ECHOCARDIOGRAPHY – A DIAGNOSTIC, PROGNOSTIC AND THERAPEUTICALLY TOOL IN SURGICAL DECISION FOR LV REMODELING

We showed that LV remodeling after MI is a progressive process to cardiac dilatation that contributes to the development of heart failure and late mortality. Therefore, early detection of the LV remodeling is of a major importance, both for assessing the cardiovascular prognostic and for deciding the optimal management of the patients with cardiac dilatation. In the last decade, we have witnessed an extraordinary development of imaging techniques, which are able to make an accurate diagnosis of LV remodeling. Echocardiography is a rapid, feasible and simple non-invasive imagistic method, and thus represents the preferred imagistic tool for quantify the cardiac remodeling and its functional consequences, and also for deciding the surgical indication even at the first hours from a MI.

2D and M-mode echocardiography provides essential information about the specifically wall thinning and endocardial motion after a MI, by meaning of dyskinesia or akinesia, and also information about the systolic and diastolic dysfunction. These conventional methods are now supplemented by the new ultrasounds
techniques, such as real-time 3Dimensional echocardiography, tissue Doppler and strain rate imaging or intraoperative echocardiography. Furthermore, stress echocardiography provides accurate information on the presence or absence of the myocardial ischemia and of the myocardial viability in each coronary artery territory, and thus critical data for patient management.

IIIa. Echocardiographic assessment of the early LV remodeling

Clinical data demonstrate that mortality post-MI remains high (12%) despite advances in medical and interventional therapies. A significant proportion of deaths are due to early LV remodeling following MI. Early LV remodeling is represented by the presence of the early aneurysm and acute mechanical complications. These complications include myocardial rupture of the left ventricular free wall, rupture of the ventricular septum and AMR (15) and they are life threatening. However, they require rapid diagnosis and urgent surgical intervention and thus, they are potentially treatable. Echocardiography is the procedure of choice for initial evaluation and detection of early LV remodeling.

- Early LV aneurysm

An early LV aneurysm is defined as a dyskinetic segment, with diastolic contour anomalies. As we already mentioned, early LV remodeling represents a wall thinning and elongation. Therefore, a true LV aneurysm is lined by thinned myocardium. For the clinical practice, it is extremely important to mention what is the percent of the dyskinesia, as showed in figure 5. We showed that LV remodeling is a progressive process and clinical data demonstrate that 20% of dyskinesia in the acute phase of MI predicts late LV remodeling and aneurysm formation, and 50% of dyskinesia predicts ICMP (16).

- Myocardial rupture of the left ventricular free wall

If the process of infarct extension continues, and LV wall became extremely thin and bulge, myocardial rupture in the free wall of the LV occurs. In this case, mortality is extremely high due to the extravasation of the blood in the pericardium space and acute pericardial tamponade. Echocardiography may establish the diagnosis and indicate urgent surgery. The echocardiographic patterns of ventricular rupture include: diffuse or localized pericardial effusion or even signs of pericardial tamponade; occasionally the location of the rupture demonstrated 2D; or the flow from the ventricle into the pericardium demonstrated with Doppler technique (17).

- Rupture of the ventricular septum

Another acute mechanical complication is a ventricular septal defect due to a rupture of a segment of the interventricular septum. The site of the ventricular rupture may be identified using 2D echocardiographic assessment, but the diagnosis is established by the presence of the high velocity left-to right systolic jet, recorded with CW –Doppler and by the systolic turbulence on the right ventricular side recorded with color – Doppler (17).

- Acute mitral regurgitation

The occurrence of the AMR in the early MI phases may be due to: papillary muscle dysfunction, abnormal wall motion and thinning of the region underlying a papillary muscle (for example in inferior myocardial infarction, when a restriction of posterior mitral leaflet occurs) or papillary muscle rupture. The presence and the severity of the AMR are established using 2D echocardiographic assessment and Doppler technique. One of the most catastrophic acute complications is the papillary muscle rupture. This can be detected using 2D method or transesophageal imaging, when the diagnosis is not clear. The marker of
the papillary muscle rupture is a flail leaflet with an attached mass (the papillary muscle) that prolapses into the left atrium.

In conclusion, we demonstrated that echocardiography is a vital tool in the diagnosis of the acute mechanical complications in MI, allowing the indication for the urgent surgery and careful monitoring of patients before, during, and after surgical repair.

IIIb. Echocardiographic assessment of the late LV remodeling

Late LV remodeling concept is defined as cardiac dilatation and alteration of the LV geometry, loss of myocardial reserve and decreased of systolic and diastolic performance, as shown in figure 6. From the clinical point of view, late LV remodeling is represented by: LV aneurysm, ischemic cardiomiopathy and chronic mitral regurgitation. Echocardiography provides a reliable method for detection of late LV remodeling, assessing prognostic factors and, furthermore, for deciding the surgical indication in patients with LV remodeling.

- **Late LV aneurysm.**
  A late LV aneurysm is defined as a dyskinetic region with systolic-diastolic contour anomalies, which appears within months after an AMI. The most frequent is apical aneurysm, but infero-basal aneurysm may be seen. Echocardiography identifies the presence of the aneurysm and provides essential anatomically information for the further cardiac surgery. Therefore, using 2D and Doppler assessment, are appreciated (shown in figure 7): localization, dimension and extension of the aneurysm, zone of the aneurysm demarcation – the aneurysm “neck”, the thickness of the aneurysm and of the ventricular wall, presence of thrombi, other dyskinetic or akinetic ventricular segments and mitral involvement.

- **Ischemic dilated cardiomiopathy.**
  ICMP defines a complex of processes leading to progressive LV dilatation, global dysfunction and heart failure in patients with MI. Echocardiographic assessment provides important data regarding the structural and functional cardiac parameters, cardiovascular prognostic and surgical decisions. Therefore, ICMP may be defined as a wall thinning and abnormal endocardial motion, resulting in cavity dilatation, with high sphericity index. Using rest and stress conventional echocardiography and also new imagistic methods, such as 3D evaluation, tissue Doppler and strain imaging, we can evaluate LV volumes and shape, systolic and diastolic LV performance, RV function and myocardial viability.

**Ejection fraction and cardiac volumes assessment**

Clinical and experimental studies showed that the life expectancy in patients with IHD is related to the functional status of the LV (18). Ejection fraction was usually used to characterized LV function and defined the prognosis after MI. Westaby showed in an article...
published in 2000, that for the patients with ICMP, the three year mortality is directly correlated with systolic dysfunction, thus for an EF < 43%, the mortality is 38% and for an EF > 43% is 6% (p=0.0029) (14). It has also been demonstrated that low EF following a MI is caused by the loss of the contractile tissue due to ischemia, on one hand, or due to the LV progressive dilatation related to infarct expansion and stretching of the myocardial scar, on the other hand (3). Thus, we may say that EF and LV volumes are closely related. In the same time, recent data showed that LV end-systolic volumes (LVESV) or end-diastolic volumes (LVEDV) are very strong predictors of life expectancy, morbidity and mortality after an AMI (19, 20).

White et al compared the individual predictive powers of LVESV, LVEDV and EF, together with other angiographic and clinical predictors of cardiac mortality in 605 patients (3). LVESV was found to be the most meaningful predictor of prognosis in patients after a MI. Westaby showed that a LVESV index > 60 ml/m² predicts one year risk of death of 33% (14). Furthermore, Hamer et al demonstrated that in patients with impaired left ventricular function after surgical revascularization, end-systolic volume is the most important predictor of long-term survival (21). Therefore, it is of major clinical importance to evaluate, not only the EF but also to measure LV volumes.

**LV diastolic function assessment**

Together with systolic impairment, diastolic dysfunction is an important functional aspects related to LV remodeling following a MI. This is caused by increases in LV stiffness due to scar formation and by delayed relaxation due to hypertrophy of the non-infarcted segments. Echocardiography demonstrated to be a feasible method to assess LV filling pattern. Previous studies have shown that abnormal mitral flow patterns is independently associated with survival in patients with left ventricular dysfunction. Thus, Cerisano et al demonstrated that the shortening of the deceleration time of the early wave on PW Doppler, a marker of restrictive filling, was the most powerful predictor of LV remodeling and of an adverse outcome in post infarction patients (22). Furthermore, another study demonstrated that an early wave deceleration time <140 ms, was independently associated with cardiac death or heart failure hospitalization (HR 5.7, p = 0.0013) (23).

**Tei Index assessment**

Tei Index is a new echocardiographic parameter which evaluates both the systolic and diastolic ventricular performance, calculated as isovolumetric relaxation time plus isovolumetric contraction time divided be the ejection time. Recent studies demonstrated that this index is an independent prognostic factor of mortality and LV remodeling following an AMI (19). Therefore, it has been demonstrated that an elevated Tei index (> 0.90) is an independent predictor of a poor cardiac prognosis (24).

**Right ventricular function assessment**

As we already showed, patients with ICMP have a high mortality rate. This may be related to the RV dysfunction following an AMI. Thus, the evaluation of the RV systolic function by meaning of TAPSE (tricuspid annular plane systolic excursion), as shown in figure 8 is a very important step for the risk assessment of these patients. The value of TAPSE has to be > 20 mm. Gureev et al demonstrated that the decrease of the systolic function of the RV could be a result of the impairment of the ventricles interaction or of the spreading of the scar to the RV myocardium. This decrease of RV function could be a predictor of the development of the low cardiac output syndrome after by pass surgery (25), and from our experience a TAPSE < 12 mm represents a contra-indication for cardiac surgery.

**FIGURE 8.** Quantification of the RV function by measuring TAPSE in Mmode

RV: right ventricle; TAPSE: tricuspid annular plane systolic excursion.
Myocardial viability assessment

In addition to detection ischemic myocardium, stress echocardiography is proposed as a method for accurate assessment of myocardial viability in patients with LV remodeling after a MI which may benefit from coronary artery bypass and surgical ventricular restoration. To make the surgical decision, the evaluation of the “stunned or hibernating” myocardium is necessary to judge whether these regions will recover with coronary vascularization (26).

Evaluation of the LV remodeling using new ultrasound techniques

As we already showed, the accurate assessment of the LV structure and functional parameters in patients with ICMP is essential for evaluation the prognosis and for deciding the treatment. The real-time 3Dimensional Echocardiography is a new ultrasound technique, which uses a small number of apical rotated views, which may rapidly reconstruct the LV cavities (27). Therefore, this method accurately calculates the LV volumes and function in patients with dilated and abnormally shaped ventricles, as showed in figure 9.

Others new echocardiographic approaches has been developed in order to evaluate the consequences of left ventricular remodeling, from which tissue Doppler and derived strain rate are the most promising. Tissue Doppler imaging (TDI) is an ultrasound technique, which allows rapid measurements of myocardial velocities of contraction and relaxation, and mechanical activation times, thus allowing assessment of ventricular synchrony. Imaging of the myocardial segments deformation defines strain rate or myocardial velocities gradient, as we can see in figure 10. This may be other marker of LV asynchrony following a MI. Recent data demonstrated that there is a strong positive correlation between LV systolic asynchrony, evaluated by TDI, and infarct size, LVESD and LVEDD and a negative correlation with a LVEF (28).

• Chronic mitral regurgitation.

Mitral regurgitation associated with ICMP develops as results of the both mitral annular dilatation and LV remodeling resulting in tethering of the mitral leaflets by displaced papillary muscles (29). Conventional 2D and 3D echocardiography are the preferred methods to evaluate the mechanisms of the CMR, as seen in figure 11. CMR after a MI is an independent predictive marker of morbidity and mortality, usually associated with a decreased LV systolic and diastolic performance. Westaby showed that the one year mortality of the CMR untreated is 54–70% (14) and Grigioni et al showed that FMR was a strong predictor of death in patients with Q-wave myocardial infarction (30).
IV. SURGICAL OPTIONS FOR THE LV REMODELING

Clinical and experimental data demonstrated that LV remodeling post MI may be hampered by some anti – remodeling agents. Unlike patients with other form of CMP, medical therapies have been found to be ineffective in patients with ICMP. Data from the coronary artery surgery study (CASS) registry showed that, for patients with LVEF < 25% five year survival was 41% with medical treatment and 62% with surgery (31). Therefore, the question remains as when to indicate cardiac surgery and what type of intervention should be used in patients with LV dilatation and dysfunction.

Various surgical options may be utilized in the treatment of the LV remodeling: 1) Coronary revascularization; 2) LV restoration; 3) Management of CMR; 4) Heart transplantation.

- Coronary revascularization in LV remodeling.
  
  Coronary artery by-pass grafting (CABG) is the most frequent surgical intervention used for the remodeling heart. Published data showed that CABG may modify the progress of the LV remodeling process. Thus, CASS study demonstrated that CABG performed in a group of patients with LVEF < 35% proved a better survival benefits compared to medical treatment (31). Furthermore, Gaszewka – Zurek et al demonstrated that LVEF significantly increased after CABG surgery and chamber volume decreased (6). As we already mentioned, the results of the coronary revascularization in LV remodeling depends on confirmation of myocardial viability (32). Carluccio and colleagues reported that the altered LV volume and shape in patients with hibernating myocardium showed significantly reversal after coronary revascularization (33). Patients with LV dilation and dysfunction without reversible ischemia do not have an improved outcome with coronary bypass. As we already showed, LESV is the strongest cardiac predictor of surgical outcome (34), coronary bypass alone improves ejection fraction only if the preoperative LVESV index is < 100 ml/m².

Non-cardiac risk factors for death include advanced age, female sex, a history of hypertension or chronic obstructive airways disease, and the presence of peripheral vascular disease or renal impairment. Finally, the preoperative mortality of patients with ICMP and low EF is kept below 10–15%. In an article published in 2000, Westaby summarized the indications for revascularization of the remodeling and dysfunctional versus heart transplantation, as shown in table 1.

We may conclude that the high risk (5–15% mortality) revascularization is the treatment of choice for patients with ejection fraction < 20%, reversible ischemia and graftable target vessels. Contraindications to coronary by-pass are pulmonary artery pressure > 60 mm Hg, right heart failure, and poor target vessels (14).

- Left ventricular restoration.

Several new techniques have been proposed for the treatment of ICMP. Initially, so called “ventricular restoration” has been developed as a technique for the treatment of LV aneurysm. Batista proposed a left ventriculectomy procedure, during which a portion of the dilated LV is removed (35), but this has fallen out because of the poor outcome. Therefore, Vincent Dor proposed other technique for surgical restoration for LV remodeling (36). The Dor procedure has extended as an alternative treatment of the LV remodeling even in the absence of aneurysm. This intervention consists in the placement of an endoventricular patch to exclude the scar region of the ventricle as shown in figure 12. The goal of surgical restoration is to reshape the left ventricle from spherical to elliptical form without critically reducing cavity volume. It has been demonstrating that patients with a good

![FIGURE 11. The mechanisms of the CMR evaluated by 2Dimensional and 3Dimensional echocardiography CMR: chronic mitral regurgitation.](image-url)
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This intervention improves global ventricular performance and slows the progression of LV remodeling. Thus, Athanasouleas et al. reported an improvement of EF from 20% to 35% and a decrease in LVESV index and LVEDV index by 39% and 29%, respectively, in subgroup of patients with apical akinesia who undergone the Dor procedure (37). Furthermore, clinical data demonstrated the modification in LV geometry after Dor procedure results in reduced degree of mitral regurgitation (14, 38). Dor procedure has an intra-hospital mortality of 12-18% if LVEF is < 20% and pulmonary arterial pressure is high and 3% in pts with LVEF >30% (36).

- Management of chronic mitral regurgitation.

As we already showed, the coexistence of CMR in patients with LV remodeling undergone the coronary revascularization is often associated with poor long-term prognostic (39). However, new data showed that surgical mitral valve repair results in low operative mortality, amelioration of the symptoms and improved medium-term prognostic due to increased of cardiac index (40). Westaby recommended the mitral repair in ischemic regurgitation when LVESV index is > 80 ml/m² or a calculated regurgitant fraction is >50% of the EF (14). Patients with mild to moderate mitral regurgitation, reversible ischemia poster laterally and well coronary vascular bed can be treated by myocardial revascularization alone (14). There have been described two surgical procedures for management of CMR. First, is undersizing mitral annuloplasty which increases leaflets coaptation and may remodels the base of the dilated LV. Second, is Alfieri stitch, as shown in the figure 13.

Heart transplantation has evolved as the treatment for ICMP which is refractory to the above surgical techniques, but the donor shortage and costs are major issues. Therefore, it has been established criteria for heart transplantation indications, as shown in the table 1.

<table>
<thead>
<tr>
<th>Coronary revascularization</th>
<th>Heart transplantation</th>
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<tbody>
<tr>
<td>Hibernating myocardium predominantly</td>
<td>Scar predominantly</td>
</tr>
<tr>
<td>Good target vessels</td>
<td>Poor target vessels</td>
</tr>
<tr>
<td>No RV failure (TAPSE&gt;17mm)</td>
<td>RV failure (TAPSE&lt;17mm)</td>
</tr>
<tr>
<td>Stable cardiac output</td>
<td>Progressively lower cardiac output</td>
</tr>
<tr>
<td>Short duration of the heart failure</td>
<td>Prolonged heart failure</td>
</tr>
<tr>
<td>First operation</td>
<td>Previous revascularization</td>
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TABLE 1. Indications for CABG in ICMP vs heart transplantation

RV: right ventricle, TAPSE: tricuspid annular plane excursion.
In conclusion, LV remodeling post MI is a progressive process that may lead to the severe heart failure. This process begins in the acute phase of MI, determines wall thinning and early mechanical complications that represent the majority cause of in-hospital death. In time, early remodeling leads to scar formation, cardiac dilatation, changes of ventricular geometry with CMR and, therefore to ventricular dysfunction. Medical treatment has been found to be ineffective for decrease the remodeling in patients with ICMP. In such cases, complex surgical procedure – coronary revascularization, ventricular restoration and mitral valve repair – represent the preferred therapeutically options. Therefore, the accurate detection of early or late LV remodeling is mandatory. Conventional echocardiography supplemented by the new ultrasound techniques are rapid, feasible and non-invasive methods, and thus represent the preferred imagistic tool for detection of cardiac dilatation and its functional consequences, for assessing the prognostic factors and for deciding the surgical indication in patients with MI.

References

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