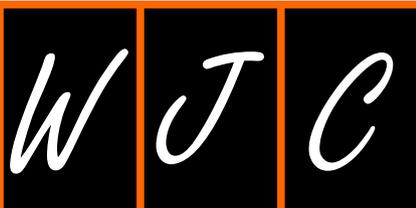


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Chronic ischemic mitral valve regurgitation and surgical perspectives

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Abstract

Chronic ischemic mitral valve regurgitation is a result of disturbed left ventricular geometry secondary to myocardial ischemia in the absence of intrinsic mitral valve pathology. It is a common complication after myocardial infarction, and patients who have ischemic mitral regurgitation (IMR) have a worse prognosis compared to patients who have ischemic heart disease alone, and this is directly related to the severity of IMR. Medical therapy has limited efficacy, and surgical options including various repair techniques and valve replacement had been tried with variable success. Still there is intense debate among surgeons whether to interfere with moderate degree IMR at the time of coronary artery revascularization.

Key words: Mitral regurgitation; Myocardial infarction; Ring annuloplasty; Valve replacement

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Core tip: Chronic ischemic mitral valve regurgitation is a valvular dysfunction secondary to myocardial infarction. Debates among surgeons surround the decision to intervene and the type of intervention in moderate degree ischemic regurgitation. A comprehensive approach addressing the whole pathology of myocardial ischemia and ventricular dysfunction may be of value.

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INTRODUCTION

Chronic ischemic mitral regurgitation (IMR) is a complication that is determined by the extent and severity of myocardial infarction as well as ventricular dyssynchrony and afterload^[1]. In contrast to primary mitral valve regurgitation caused by structural valve abnormality in which there is an increasing agreement among surgeons for therapeutic options, IMR management options are still a matter of debate among clinicians^[2].

An increasing consensus among authors indicates that a severe form of IMR should be corrected, however surgical intervention with moderate forms of IMR at the time of coronary revascularization is still a matter of debate^[3]. There has been an evolution in surgical techniques of mitral valve repair over the years, however the continuous left ventricular remodeling process resulting in recurrence of the valve incompetence remained a major drawback of this approach^[4]. Mitral valve replacement preserving the subvalvular apparatus demonstrated a more durable valve competence and comparable left ventricular reverse remodeling and survival at a two year follow up period in comparison with mitral valve repair^[5].

DEFINITION AND BURDEN OF ISCHEMIC MITRAL VALVE REGURGITATION

IMR is defined classically as mitral valve regurgitation due to a previous myocardial infarction^[1]. Based on this definition, left ventricular remodeling consequences are considered integral parts leading to the development of IMR following myocardial infarction. Therefore, IMR is a complication of myocardial infarction due to structural left ventricular dysfunction in the presence of normal intrinsic mitral valve structure^[6]. This definition takes into consideration both the history of myocardial infarction as well as the resulting left ventricular abnormalities together. IMR is not a mitral valve disease per say, but a consequence of the disturbed closing and tethering forces related to the papillary muscle mechanics as a result of left ventricular remodeling following myocardial infarction^[6]. Other mitral valve pathologies may coexist with a previous history of myocardial infarction like rheumatic or myxomatous mitral valve disease. These do not indicate an ischemic mitral valve disease, therefore the description of the mitral valve regurgitation depends on the mitral valve structure and the left ventricular structural dysfunction. Carpentier classification in 1983 characterized the pathophysiology of IMR to either 1. Mitral leaflet motion restriction in systole, type III b or 2.

Isolated mitral annular dilatation, type I a^[7].

IMR is a significant clinical problem that affects 1.6-2.8 million people in the United States and it may happen in 10%-20% of patients with ischemic heart disease^[5,8]. With the new technologies implemented in the current era of coronary artery interventions and the aging population, one can expect that the incidence of IMR will increase, which had been demonstrated to have a significant negative impact on patient survival and the development of heart failure^[9].

Grigioni *et al*^[9] demonstrated in patients with Q wave after myocardial infarction that the prevalence of adverse events had been linked directly to the presence and degree of severity of IMR. When patients are matched in their base line characteristics those who had a severe degree of IMR (ERO > 20 mm) are six times more likely to have heart failure compared to patients without IMR regardless of the symptomatology status (RR 6.4, 95%CI: 2.9 to 14.3; $P < 0.0001$). Therefore, detecting and quantifying IMR is highly crucial in planning a treatment strategy following myocardial infarction.

CHOICE OF SURGICAL INTERVENTION IN SEVERE IMR, REPAIR VS REPLACEMENT

There is an agreement among clinicians that severe IMR should be surgically treated, however treatment of moderate IMR is still a matter of debate^[10]. Many changes have occurred in surgical approaches over the past years. Initially, mitral valve replacement with excision of the mitral valve apparatus was the primary choice because it restores the competency of the valve. The drawback of this approach is the impaired left ventricular function and geometry due to excision of the subvalvular apparatus^[8]. Mitral valve repair using ring annuloplasty was another solution because it preserves the subvalvular apparatus and theoretically preserves the mitral valve competency. Proponents of this therapeutic modality take in consideration the unique shape of the mitral annular configuration in determining the mitral competence by decreasing the leaflet stress during systole^[11]. This approach does work for type I IMR, however it incompletely corrects type III b dysfunction. The ideal solution is to adopt a comprehensive approach that will take all the aspects of the disease in consideration. Physiological changes are asymmetric in the left ventricle geometry as well as the annulus, so new advances had been designed even in the ring technology to reshape the annulus taking in consideration the saddle pattern of the mitral annular configuration^[12].

Whether to replace or repair severe chronic ischemic mitral valve regurgitation has been a subject of intense debate. The tradeoff between the durability of mitral valve repair is correcting a regurgitant valve vs an adverse consequence of prosthetic valve insertion. It was observed that patients, who had severe ischemic mitral valve regurgitation demonstrated a comparable

degree of left ventricular reverse remodeling between mitral valve repair and replacement at one year follow up^[5]. However, the rates of recurrent mitral valve regurgitation amongst the survivors of the repair cohort were 32.6% at one year and 46% at the two year follow up^[5]. Other forms of surgical options addressing the left ventricular geometrical changes had been tried with variable success rates. Fattouch *et al.*^[13] reported a durable mitral valve repair with less than 3% recurrence rate of moderate mitral valve regurgitation by adopting papillary muscle relocation, non-restrictive mitral annuloplasty, and myocardial revascularization in patients with severe IMR.

Lorusso *et al.*^[14] demonstrated that there was a comparable incidence of adverse outcomes between the repair and replacement matched groups in the short and long term follow up periods in patients with severe ischemic mitral valve regurgitation. However, mitral valve repair remained the strongest predictor for the need for mitral valve re-operation^[14].

MODERATE IMR AT THE TIME OF CORONARY ARTERY BYPASS GRAFT

There is general agreement among clinicians that significant IMR should be addressed at the time of coronary artery bypass graft (CABG). However, the drawback of this approach is that a combined procedure may increase the risk of surgery on a sick heart and doing coronary revascularization alone may improve ventricular status. Whether to treat moderate IMR at the time of CABG has been a real debate in the field of cardiology and cardiac surgery. This led to the conduction of four randomized controlled trials, which are the only ones published until now addressing this subject^[3,15-17].

Fattouch *et al.*^[3] concluded that a mitral valve intervention for significant functional mitral valve regurgitation at the time of CABG might improve the degree of functional mitral regurgitation, the New York Heart association functional class, and left ventricular ejection fraction. Chan *et al.*^[16] observed similar results as Fattouch *et al.* They demonstrated that there was an improvement in the degree of functional mitral regurgitation, reverse left ventricular remodeling, and functional capacity when mitral valve repair was added to coronary artery revascularization in the presence of moderate IMR.

A more recent conducted trial by Bouchard *et al.*^[15] demonstrated that there was no obvious clinical benefits of adding mitral valve intervention at the time of CABG after one year follow up, despite the tempting value early in the post-operative period. However, the major drawback of this trial is that it included only 31 patients in both cohorts. Smith *et al.*^[17] demonstrated that there was some degree of improvement of the mitral valve grade in association with mitral valve repair at the time of CABG. However, the incidence of adverse events was increased.

Evidence from observational studies also has been

a matter of debate. Aklog *et al.*^[18] demonstrated that there was clear superiority in performing mitral valve repair for moderate IMR at the time of CABG compared to revascularization alone in correcting mitral valve incompetence. Kang *et al.*^[19] demonstrated in their study that the addition of mitral valve intervention might increase operative mortality compared to patients who have CABG alone.

With these conflicting results in the randomized controlled trials addressing this issue, Altarabsheh *et al.*^[20] published a systemic review and meta-analysis in 2017 that included the four randomized trials and seven relevant observational studies with a total of 1447 patients. They clearly demonstrated that the addition of mitral valve repair for moderate IMR at the time of CABG did not have survival or functional improvement at the five year follow up despite the fact that it may improve the degree of mitral valve competence.

CONCLUSION

IMR remains a significant complication of myocardial infarction and continued to have therapeutic challenges. Complex mechanisms involving mitral annulus and subvalvular apparatus play a role, and ideal surgical repair should take the whole pathology in consideration. Future repair techniques, which address disturbed left ventricular mechanics, may be of value, and currently mitral valve replacement preserving the subvalvular apparatus is a valid surgical option. Moderate IMR could be addressed by coronary revascularization alone at the time of CABG.

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