

# World Journal of *Cardiology*

*World J Cardiol* 2018 October 26; 10(10): 123-190



**EDITORIAL**

- 123 T-cells in myocardial infarction: Culprit instigators or mere effectors?

*Liberale L, Bonaventura A, Montecucco F*

**REVIEW**

- 127 Overview of coronary artery variants, aberrations and anomalies

*Kastellanos S, Aznaouridis K, Vlachopoulos C, Tsiamis E, Oikonomou E, Tousoulis D*

**MINIREVIEWS**

- 141 Chronic ischemic mitral valve regurgitation and surgical perspectives

*Altarabsheh SE, Deo SV, Rababa'h A, Obeidat YM, Haddad O*

**ORIGINAL ARTICLE****Observational Study**

- 145 Successful endovascular treatment in patients with acute thromboembolic ischemia of the lower limb including the crural arteries

*Giusca S, Raupp D, Dreyer D, Eisenbach C, Korosoglou G*

- 153 Incidental congenital coronary artery vascular fistulas in adults: Evaluation with adenosine-<sup>13</sup>N-ammonia PET-CT

*Said SAM, Agool A, Moons AHM, Basalus MWZ, Wagenaar NRL, Nijhuis RLG, Schroeder-Tanka JM, Slart RHJA*

**SYSTEMATIC REVIEW**

- 165 Undiscovered pathology of transient scaffolding remains a driver of failures in clinical trials

*Kharlamov AN*

**CASE REPORT**

- 187 Takotsubo syndrome - different presentations for a single disease: A case report and review of literature

*Fuensalida A, Cortés M, Gabrielli L, Méndez M, Martínez A, Martínez G*

**ABOUT COVER**

Editorial Board Member of *World Journal of Cardiology*, Mahesh Anantha-Narayanan, MD, Academic Fellow, Doctor, Division of Cardiovascular Sciences, University of Minnesota, Minneapolis, MN 55455, United States

**AIM AND SCOPE**

*World Journal of Cardiology* (*World J Cardiol*, *WJC*, online ISSN 1949-8462, DOI: 10.4330) is a peer-reviewed open access journal that aims to guide clinical practice and improve diagnostic and therapeutic skills of clinicians.

*WJC* covers topics concerning arrhythmia, heart failure, vascular disease, stroke, hypertension, prevention and epidemiology, dyslipidemia and metabolic disorders, cardiac imaging, pediatrics, nursing, and health promotion. Priority publication will be given to articles concerning diagnosis and treatment of cardiology diseases. The following aspects are covered: Clinical diagnosis, laboratory diagnosis, differential diagnosis, imaging tests, pathological diagnosis, molecular biological diagnosis, immunological diagnosis, genetic diagnosis, functional diagnostics, and physical diagnosis; and comprehensive therapy, drug therapy, surgical therapy, interventional treatment, minimally invasive therapy, and robot-assisted therapy.

We encourage authors to submit their manuscripts to *WJC*. We will give priority to manuscripts that are supported by major national and international foundations and those that are of great basic and clinical significance.

**INDEXING/ABSTRACTING**

*World Journal of Cardiology* (*WJC*) is now abstracted and indexed in Emerging Sources Citation Index (Web of Science), PubMed, PubMed Central, Scopus, China National Knowledge Infrastructure (CNKI), and Superstar Journals Database.

**EDITORS FOR THIS ISSUE**

**Responsible Assistant Editor:** *Xiang Li*  
**Responsible Electronic Editor:** *Yun-Xiao Jian Wu*  
**Proofing Editor-in-Chief:** *Lian-Sheng Ma*

**Responsible Science Editor:** *Ying Dou*  
**Proofing Editorial Office Director:** *Jin-Lei Wang*

**NAME OF JOURNAL**

*World Journal of Cardiology*

**ISSN**

ISSN 1949-8462 (online)

**LAUNCH DATE**

December 31, 2009

**FREQUENCY**

Monthly

**EDITORIAL BOARD MEMBERS**

All editorial board members resources online at <http://www.wjgnet.com/1949-8462/editorialboard.htm>

**EDITORIAL OFFICE**

Jin-Lei Wang, Director  
*World Journal of Cardiology*  
Baishideng Publishing Group Inc

7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA

Telephone: +1-925-2238242

Fax: +1-925-2238243

E-mail: [editorialoffice@wjgnet.com](mailto:editorialoffice@wjgnet.com)

Help Desk: <http://www.f6publishing.com/helpdesk>

<http://www.wjgnet.com>

**PUBLISHER**

Baishideng Publishing Group Inc

7901 Stoneridge Drive, Suite 501,

Pleasanton, CA 94588, USA

Telephone: +1-925-2238242

Fax: +1-925-2238243

E-mail: [bpgooffice@wjgnet.com](mailto:bpgooffice@wjgnet.com)

Help Desk: <http://www.f6publishing.com/helpdesk>

<http://www.wjgnet.com>

**PUBLICATION DATE**

October 26, 2018

**COPYRIGHT**

© 2018 Baishideng Publishing Group Inc. Articles published by this Open-Access journal are distributed under the terms of the Creative Commons Attribution Non-commercial License, which permits use, distribution, and reproduction in any medium, provided the original work is properly cited, the use is non commercial and is otherwise in compliance with the license.

**SPECIAL STATEMENT**

All articles published in journals owned by the Baishideng Publishing Group (BPG) represent the views and opinions of their authors, and not the views, opinions or policies of the BPG, except where otherwise explicitly indicated.

**INSTRUCTIONS TO AUTHORS**

<http://www.wjgnet.com/bpg/gerinfo/204>

**ONLINE SUBMISSION**

<http://www.f6publishing.com>

## Chronic ischemic mitral valve regurgitation and surgical perspectives

Salah Eldien Altarabsheh, Salil V Deo, Abeer Rababa'h, Yagthan M Obeidat, Osama Haddad

Salah Eldien Altarabsheh, Division of Cardiovascular Surgery, Queen Alia Heart Institute, Amman 11953, Jordan

Salil V Deo, Division of Cardiovascular Surgery, Harrington Heart and Vascular Institute, Case Western Reserve University, Cleveland, OH 44106, United States

Abeer Rababa'h, Department of Clinical Pharmacy, Jordan University of Science and Technology, Irbid 22110, Jordan

Yagthan M Obeidat, Department of Cardiac Surgery, AlMana General Hospital, AL Khobar 31952, Saudi Arabia

Osama Haddad, Department of Thoracic and Cardiovascular Surgery, Cleveland Clinic, Cleveland, OH 44195, United States

ORCID number: Salah Eldien Altarabsheh (0000-0002-1328-3340); Salil V Deo (0000-0002-4729-1461); Abeer Rababa'h (0000-0003-4619-2012); Yagthan M Obeidat (0000-0001-6551-9274); Osama Haddad (0000-0001-6308-6372).

**Author contributions:** Altarabsheh SE and Deo SV had almost equal contributions in writing the manuscript; Obeidat YM and Haddad O had equal contribution in editing the manuscript; Rababa'h A reviewed the manuscript.

**Conflict-of-interest statement:** We do not have any relevant disclosure pertaining to this study.

**Open-Access:** This article is an open-access article, which was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>

**Manuscript source:** Invited manuscript

**Correspondence to:** Salah Eldien Altarabsheh, MD, Consultant Cardiac Surgeon, Division of Cardiovascular Surgery, Queen Alia Heart Institute, Queen Rania St., Amman 11953, Jordan. [salah936@yahoo.com](mailto:salah936@yahoo.com)

Telephone: +962-77-7181844  
Fax: +962-2-7201075

Received: June 25, 2018  
Peer-review started: June 26, 2018  
First decision: July 9, 2018  
Revised: August 4, 2018  
Accepted: August 6, 2018  
Article in press: August 7, 2018  
Published online: October 26, 2018

### 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

© The Author(s) 2018. Published by Baishideng Publishing Group Inc. All rights reserved.

**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.

Altarabsheh SE, Deo SV, Rababa'h A, Obeidat YM, Haddad O. Chronic ischemic mitral valve regurgitation, surgical perspectives. *World J Cardiol* 2018; 10(10): 141-144 Available from: URL: <http://www.wjgnet.com/1949-8462/full/v10/i10/141.htm> DOI: <http://dx.doi.org/10.4330/wjc.v10.i10.141>

## 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<sup>[1]</sup>. 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<sup>[2]</sup>.

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<sup>[3]</sup>. 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<sup>[4]</sup>. 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<sup>[5]</sup>.

## DEFINITION AND BURDEN OF ISCHEMIC MITRAL VALVE REGURGITATION

IMR is defined classically as mitral valve regurgitation due to a previous myocardial infarction<sup>[1]</sup>. 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<sup>[6]</sup>. 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<sup>[6]</sup>. 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 IIIb or 2.

Isolated mitral annular dilatation, type I a<sup>[7]</sup>.

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<sup>[5,8]</sup>. 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<sup>[9]</sup>.

Grigioni *et al*<sup>[9]</sup> 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<sup>[10]</sup>. 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<sup>[8]</sup>. 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<sup>[11]</sup>. This approach does work for type I IMR, however it incompletely corrects type IIIb 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<sup>[12]</sup>.

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<sup>[5]</sup>. 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<sup>[5]</sup>. Other forms of surgical options addressing the left ventricular geometrical changes had been tried with variable success rates. Fattouch *et al*<sup>[13]</sup> 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*<sup>[14]</sup> 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<sup>[14]</sup>.

## 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<sup>[3,15-17]</sup>.

Fattouch *et al*<sup>[3]</sup> 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*<sup>[16]</sup> 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*<sup>[15]</sup> 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*<sup>[17]</sup> 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*<sup>[18]</sup> 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*<sup>[19]</sup> 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*<sup>[20]</sup> 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.

## REFERENCES

- 1 Nappi F, Spadaccio C, Chello M, Mihos CG. Papillary muscle approximation in mitral valve repair for secondary MR. *J Thorac Dis* 2017; **9**: S635-S639 [PMID: 28740718 DOI: 10.21037/jtd.2017.06.98]
- 2 Tolis G Jr, Sundt TM 3rd. Surgical Strategies for Management of Mitral Regurgitation: Recent Evidence from Randomized Controlled Trials. *Curr Atheroscler Rep* 2015; **17**: 67 [PMID: 26486511 DOI: 10.1007/s11883-015-0549-y]
- 3 Fattouch K, Guccione F, Sampognaro R, Panzarella G, Corrado E, Navarra E, Calvaruso D, Ruvolo G. POINT: Efficacy of adding mitral valve restrictive annuloplasty to coronary artery bypass grafting in patients with moderate ischemic mitral valve regurgitation: a randomized trial. *J Thorac Cardiovasc Surg* 2009; **138**: 278-285 [PMID: 19619766 DOI: 10.1016/j.jtcvs.2008.11.010]
- 4 Hung J, Papakostas L, Tahta SA, Hardy BG, Bollen BA, Duran CM, Levine RA. Mechanism of recurrent ischemic mitral regurgitation after annuloplasty: continued LV remodeling as a moving target. *Circulation* 2004; **110**: II85-II90 [PMID: 15364844 DOI: 10.1161/01.CIR.0000138192.65015.45]
- 5 Acker MA, Parides MK, Perrault LP, Moskowitz AJ, Gelijns AC, Voisine P, Smith PK, Hung JW, Blackstone EH, Puskas JD, Argenziano M, Gammie JS, Mack M, Ascheim DD, Bagiella E, Moquete EG, Ferguson TB, Horvath KA, Geller NL, Miller MA, Woo YJ, D'Alessandro DA, Ailawadi G, Dagenais F, Gardner TJ, O'Gara PT, Michler RE, Kron IL; CTSN. Mitral-valve repair versus replacement for severe ischemic mitral regurgitation. *N Engl J Med* 2014; **370**: 23-32 [PMID: 24245543 DOI: 10.1056/NEJMoa1312808]

- 6 **Varma PK**, Krishna N, Jose RL, Madkaiker AN. Ischemic mitral regurgitation. *Ann Card Anaesth* 2017; **20**: 432-439 [PMID: 28994679 DOI: 10.4103/aca.ACA\_58\_17]
- 7 **Carpentier A**. Cardiac valve surgery--the "French correction". *J Thorac Cardiovasc Surg* 1983; **86**: 323-337 [PMID: 6887954]
- 8 **Boyd JH**. Ischemic mitral regurgitation. *Circ J* 2013; **77**: 1952-1956 [PMID: 23877709 DOI: 10.1253/circj.CJ-13-0743]
- 9 **Grigioni F**, Detaint D, Avierinos JF, Scott C, Tajik J, Enriquez-Sarano M. Contribution of ischemic mitral regurgitation to congestive heart failure after myocardial infarction. *J Am Coll Cardiol* 2005; **45**: 260-267 [PMID: 15653025 DOI: 10.1016/j.jacc.2004.10.030]
- 10 **Fattouch K**, Castrovinci S, Murana G, Moscarelli M, Speziale G. Surgical management of moderate ischemic mitral valve regurgitation: Where do we stand? *World J Cardiol* 2014; **6**: 1218-1222 [PMID: 25429333 DOI: 10.4330/wjc.v6.i11.1218]
- 11 **Grewal J**, Suri R, Mankad S, Tanaka A, Mahoney DW, Schaff HV, Miller FA, Enriquez-Sarano M. Mitral annular dynamics in myxomatous valve disease: new insights with real-time 3-dimensional echocardiography. *Circulation* 2010; **121**: 1423-1431 [PMID: 20231533 DOI: 10.1161/CIRCULATIONAHA.109.901181]
- 12 **Daimon M**, Fukuda S, Adams DH, McCarthy PM, Gillinov AM, Carpentier A, Filsoufi F, Abascal VM, Rigolin VH, Salzberg S, Huskin A, Langenfeld M, Shiota T. Mitral valve repair with Carpentier-McCarthy-Adams IMR ETlogix annuloplasty ring for ischemic mitral regurgitation: early echocardiographic results from a multi-center study. *Circulation* 2006; **114**: 1588-1593 [PMID: 16820643 DOI: 10.1161/CIRCULATIONAHA.105.001347]
- 13 **Fattouch K**, Castrovinci S, Murana G, Dioguardi P, Guccione F, Nasso G, Speziale G. Papillary muscle relocation and mitral annuloplasty in ischemic mitral valve regurgitation: midterm results. *J Thorac Cardiovasc Surg* 2014; **148**: 1947-1950 [PMID: 24656671 DOI: 10.1016/j.jtcvs.2014.02.047]
- 14 **Lorusso R**, Gelsomino S, Vizzardi E, D'Aloia A, De Cicco G, Lucà F, Parise O, Gensini GF, Stefano P, Livi U, Vendramin I, Pacini D, Di Bartolomeo R, Miceli A, Varone E, Glauber M, Parolari A, Giuseppe Arlati F, Alamanni F, Serraino F, Renzulli A, Messina A, Troise G, Mariscalco G, Cottini M, Beghi C, Nicolini F, Gherli T, Borghetti V, Pardini A, Caimmi PP, Micalizzi E, Fino C, Ferrazzi P, Di Mauro M, Calafiore AM; ISTIMIR Investigators. Mitral valve repair or replacement for ischemic mitral regurgitation? The Italian Study on the Treatment of Ischemic Mitral Regurgitation (ISTIMIR). *J Thorac Cardiovasc Surg* 2013; **145**: 128-139; discussion 137-138 [PMID: 23127376 DOI: 10.1016/j.jtcvs.2012.09.042]
- 15 **Bouchard D**, Jensen H, Carrier M, Demers P, Pellerin M, Perrault LP, Lambert J. Effect of systematic downsizing rigid ring annuloplasty in patients with moderate ischemic mitral regurgitation. *J Thorac Cardiovasc Surg* 2014; **147**: 1471-1477 [PMID: 23856201 DOI: 10.1016/j.jtcvs.2013.05.024]
- 16 **Chan KM**, Punjabi PP, Flather M, Wage R, Symmonds K, Roussin I, Rahman-Haley S, Pennell DJ, Kilner PJ, Dreyfus GD, Pepper JR; RIME Investigators. Coronary artery bypass surgery with or without mitral valve annuloplasty in moderate functional ischemic mitral regurgitation: final results of the Randomized Ischemic Mitral Evaluation (RIME) trial. *Circulation* 2012; **126**: 2502-2510 [PMID: 23136163 DOI: 10.1161/CIRCULATIONAHA.112.143818]
- 17 **Smith PK**, Puskas JD, Ascheim DD, Voisine P, Gelijns AC, Moskowitz AJ, Hung JW, Parides MK, Ailawadi G, Perrault LP, Acker MA, Argenziano M, Thourani V, Gammie JS, Miller MA, Pagé P, Overbey JR, Bagiella E, Dagenais F, Blackstone EH, Kron IL, Goldstein DJ, Rose EA, Moquete EG, Jeffries N, Gardner TJ, O' Gara PT, Alexander JH, Michler RE; Cardiothoracic Surgical Trials Network Investigators. Surgical treatment of moderate ischemic mitral regurgitation. *N Engl J Med* 2014; **371**: 2178-2188 [PMID: 25405390 DOI: 10.1056/NEJMoa1410490]
- 18 **Aklog L**, Filsoufi F, Flores KQ, Chen RH, Cohn LH, Nathan NS, Byrne JG, Adams DH. Does coronary artery bypass grafting alone correct moderate ischemic mitral regurgitation? *Circulation* 2001; **104**: 168-175 [PMID: 11568033 DOI: 10.1161/hc37t1.094706]
- 19 **Kang DH**, Kim MJ, Kang SJ, Song JM, Song H, Hong MK, Choi KJ, Song JK, Lee JW. Mitral valve repair versus revascularization alone in the treatment of ischemic mitral regurgitation. *Circulation* 2006; **114**: 1499-1503 [PMID: 16820626 DOI: 10.1161/CIRCULATIONAHA.105.000398]
- 20 **Altarabsheh SE**, Deo SV, Dunlay SM, Erwin PJ, Obeidat YM, Navale S, Markowitz AH, Park SJ. Meta-Analysis of Usefulness of Concomitant Mitral Valve Repair or Replacement for Moderate Ischemic Mitral Regurgitation With Coronary Artery Bypass Grafting. *Am J Cardiol* 2017; **119**: 734-741 [PMID: 28109559 DOI: 10.1016/j.amjcard.2016.11.024]

**P- Reviewer:** Li S, Ueda H, Said SAM **S- Editor:** Ji FF

**L- Editor:** Filipodia **E- Editor:** Wu YXJ





Published by **Baishideng Publishing Group Inc**  
7901 Stoneridge Drive, Suite 501, Pleasanton, CA 94588, USA  
Telephone: +1-925-223-8242  
Fax: +1-925-223-8243  
E-mail: [bpgoffice@wjgnet.com](mailto:bpgoffice@wjgnet.com)  
Help Desk: <http://www.f6publishing.com/helpdesk>  
<http://www.wjgnet.com>

