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Role of Tissue Doppler Echocardiography in Assessment of Post Myocardial Infarction Ischemic Mitral Regurgitation

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دور التصوير بالدوبلر النسيجي في تقييم ارتجاع الصمام التاجي الناجم عن قصور الشرايين التاجية بعد إحتشاء عضلة القلب

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Abstract:
Ischemic mitral regurgitation (IMR) represents a common sequela of myocardial infarction and arises primarily from adverse left ventricular (LV) remodeling rather than intrinsic mitral valve pathology. Alterations in LV geometry lead to papillary muscle displacement and leaflet tethering, resulting in functional regurgitation. Variations in tethering configuration, namely symmetric and asymmetric patterns, are thought to influence the mechanism and severity of chronic IMR. This study sought to investigate the relationship between IMR mechanisms, regurgitation severity, and mitral annular deformation using two-dimensional echocardiography and tissue Doppler imaging (TDI).Twenty-four patients with chronic post-infarction IMR were prospectively enrolled and classified according to tethering pattern into symmetric ($n = 15$) and asymmetric ($n = 9$) groups. Comprehensive transthoracic echocardiography was performed to assess LV remodeling, mitral valve deformation indices, and MR severity using quantitative Doppler techniques. Regional systolic and diastolic mitral annular velocities were evaluated at six annular sites using TDI.Symmetric tethering was consistently associated with centrally directed regurgitant jets, whereas asymmetric tethering demonstrated posteriorly directed jets. Although LV dimensions and ejection fraction were comparable between groups, patients with asymmetric IMR exhibited significantly larger effective regurgitant orifice area, regurgitant volume, and regurgitant fraction ($p < 0.05$). In contrast, symmetric IMR was characterized by significantly greater coaptation height, tenting area, and mitral annular area ($p < 0.01$). TDI analysis revealed more diffuse systolic dysfunction in symmetric IMR, while asymmetric IMR showed regionally confined abnormalities corresponding to infarcted myocardial segments.These findings indicate that IMR comprises distinct echocardiographic phenotypes determined by leaflet tethering pattern, each associated with specific ventricular remodeling characteristics, mitral valve deformation, and regurgitation severity. Mitral annular TDI provides incremental value in assessing regional and global LV function in this population.

Keywords: Chronic Ischemic mitral regurgitation, Echocardiography, Ventricular remodeling, Mitral valve tethering, Mitral valve tenting, Tenting height, Tenting area, Mitral annulus dilatation, Myocardial infarction.

الملخص
يُعدّ ارتجاع الصمام التاجي الإقفاري من المضاعفات الشائعة بعد احتشاء عضلة القلب، وينتج عن تغيرات هندسية ووظيفية في البطين الأيسر. تُشوّه هذه التغيرات جهاز الصمام التاجي بالرغم من سلامة وريقات الصمام من الناحية الهيكلية، قد يؤثر كل من مدى ونمط تثبيت وريقات الصمام التاجي، سواء كان متناظرًا أو غير متناظر، بشكل كبير على شدة وآلية قصور الصمام التاجي المزمن. هدفت هذه الدراسة إلى تقييم العلاقة بين آليات قصور الصمام التاجي، وشدته، وتشوه الحلقة التاجية الذي تم تقييمه باستخدام تخطيط صدى القلب والدوبلر النسيجي. تم إدخال أربعة وعشرين مريضًا يعانون من قصور الصمام التاجي المزمن بعد احتشاء عضلة القلب، وتم تصنيفهم إلى مجموعتين وفقًا لنمط التثبيت تم تقسيم المرضى إلى مجموعتين: متناظرة (15) وغير متناظرة (9). أُجري تخطيط صدى القلب عبر الصدر لتقييم إعادة تشكيل البطين الأيسر على المستويين

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الكلي والموضعي، ومؤشرات تشوه الصمام التاجي، ودرجة ارتجاع الصمام التاجي باستخدام طرق الدوبلر الكمية. كما أجري تصوير دوبلر النسيجي لستة مواقع في حلقة الصمام التاجي لتقييم وظائف الانقباض والانبساط الموضعية. وكشفت هذه الدراسة أن تدفق ارتجاع الصمام التاجي كان مركزيًا في جميع الحالات المتناظرة، بينما كان خلفيًا في المجموعة غير المتناظرة على الرغم من عدم وجود اختلاف كبير في أبعاد البطين الأيسر وكسر القذف بين المجموعتين، فقد أظهرت المجموعة غير المتناظرة زيادةً ملحوظةً في مساحة فتحة الارتجاع الفعالة وحجم الارتجاع وكسر الارتجاع التاجي (< 0.05). في المقابل، أظهرت المجموعة المتناظرة زيادةً ملحوظةً في ارتفاع نقطة التقاء الصمام، ومساحة منطقة التمدد، ومساحة حلقة الصمام التاجي (< 0.01) كشف التصوير النسيجي الدوبلري عن انخفاضات شاملة في الإجهاد الانقباضي في حالات قصور الصمام التاجي المتناظر، بينما أظهر قصور الصمام التاجي غير المتناظر تشوهات موضعية أكثر في الإجهاد تتوافق مع مناطق الاحتشاء. أظهرت هذه الدراسة إمكانية التمييز بين الأنماط الإيكوغرافية المتميزة لقصور الصمام التاجي بناءً على أنماط تثبيت وريقات الصمام التاجي. يرتبط التثبيت المتناظر وغير المتناظر بدرجات متفاوتة من إعادة تشكيل البطين الأيسر، وتشوه الصمام التاجي، وشدة قصور الصمام التاجي. ترتبط سرعات حلقة الصمام التاجي المستمدة من التصوير النسيجي الدوبلري بتشوهات حركة جدار القلب الإقليمية، وتوفر رؤى قيّمة حول وظيفة الانقباض الشاملة للبطين الأيسر.

الكلمات المفتاحية: ارتجاع الصمام التاجي الإقفاري المزمن، تخطيط صدى القلب (إيكو)، إعادة تشكيل البطين، تقييد الصمام التاجي، نقطة التقاء الصمام، مساحة منطقة التمدد، مساحة حلقة الصمام التاجي، احتشاء عضلة القلب.

Introduction

ischemic mitral regurgitation (IMR) is a common complication following myocardial infarction and is associated with an unfavorable clinical prognosis. Although the mitral valve leaflets and chordae tendinae are structurally normal, post-infarction geometric remodeling of the left ventricle—particularly papillary muscle displacement and leaflet tethering results in functional mitral regurgitation. Among these mechanisms, systolic mitral valve tenting is considered the primary determinant of IMR, while annular dilation plays a contributory role.

Variations in leaflet tethering geometry give rise to distinct echocardiographic phenotypes of chronic IMR. In patients with restricted leaflet motion, two principal tethering patterns have been identified: symmetric tethering, characterized by apical displacement of both leaflets, and asymmetric tethering, predominantly involving posterior leaflet restriction. Each pattern is associated with specific left ventricular remodeling characteristics, regurgitant jet direction, and severity of mitral regurgitation.

The aim of the present study was to evaluate the relationship between ischemic mitral regurgitation mechanisms, regurgitation severity, and mitral annular deformation using two-dimensional echocardiography and tissue Doppler imaging in patients with previous myocardial infarction

Patients

this study included 24 patients diagnosed with mitral regurgitation secondary to post-infarction left ventricular dysfunction. All patients had a documented history of ST-segment elevation myocardial infarction (STEMI) occurring more than one week prior to enrollment and demonstrated one or more regional left ventricular wall motion abnormalities on echocardiographic examination. Only patients with structurally normal mitral valve leaflets and chordae tendinae were included.

Participants were recruited from the echocardiography laboratory of the Cardiology Department at Alexandria Main University Hospital. Written informed consent was obtained from all patients prior to participation in the study.

Exclusion Criteria:

1. History of known non-ischaemic mitral regurgitation.
2. History of non-ischaemic LV dysfunction.
3. History of LBBB, or RBBB.
4. Patients with history of CABG.

Methods

All patients in this study were subjected to the following:

1- **History taking:**

- Demographic data: age and gender.
- Risk factors of coronary artery disease.
- History of present complaint.
- History of myocardial infarction (date, mode of presentation, ischemia distribution, time and mode of reperfusion, complication and history of ischaemic events before).
- Drug history.

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2- Complete clinical examination:

Complete clinical examination was done with special concern for general and cardiac examination.

3- Resting 12 leads ECG.

4- Resting transthoracic echocardiography:

- Two-dimensional echocardiography: segmental wall motion of the left ventricle was assessed by visual quantitative analysis by dividing the left ventricle into 16 segments according to the recommendation of American society of Echocardiography and measurement of ejection fraction by area-length method.
- M-mode for measurement of LV end-diastolic and end-systolic dimensions.
- Doppler echocardiography for evaluation of LV diastolic function, transmitral diastolic flow tracing, the peak early transmitral filling velocity E, peak transmitral atrial filling velocity during late diastole A, their ratio E/A, and deceleration time DT were recorded.
- Doppler colour flow echocardiographic image for assessment of mitral regurgitation degree by measuring:

1. The size of regurgitation jet area to left atrium.
2. The proximal isovelocity surface area (PISA) method: for quantitating valvular regurgitation. PkV_{Reg} (peak velocity of the regurgitant jet) determined by continuous wave doppler. Reg flow (regurgitant flow). EROA (effective regurgitant orifice area).
3. Reg flow=$6.28r^2 \times Va$
4. effective regurgitant orifice area(EROA):Reg flow/ PkV_{Reg}
5. Vena Contracta: the width of the narrowest portion of the jet.

- **Assessment of mitral valve geometric deformation:** annular dimension, coaptation depth, and tenting area assessed in long-axis view in the mesosystolic phase of the cardiac cycle are the most important parameters to describe the degree of MV apparatus deformation.

- Doppler tissue echocardiography (DTE) for measurement of mitral annular velocities: peak systolic (Sm), early diastolic motion (Em), late diastolic motion (Am) velocity and the ratio of peak early transmitral filling velocity to the early diastolic velocity of the mitral annulus (E/Em), Sample volumes were set on endocardial portions at 6 mitral annular sites adjacent to base of ventricular septum and left ventricular posterior wall. *1*, Anteroseptal wall; *2*, posterior wall; *3*, posteroseptal wall; *4*, lateral wall; *5*, anterior wall; *6*, inferior wall.

Results:

Baseline characteristics

The clinical characteristics of the patients are presented in Table 1. Fifteen patients presented with symmetric pattern and nine patients with asymmetric pattern.

Regarding to ischemic distribution, fifteen patients (62.5%) had anterior ST elevation myocardial infarction (STEMI), and nine patients (37.5%) had inferior STEMI, from those; twenty patients (83.3%) received thrombolytic therapy, and four patients (16.7%) had primary PCI, there was a significantly higher percentage of patients in NYHA class II in the symmetric group (Table 1).

Table (1) Baseline characteristics.

	symmetric group (n=15)	Asymmetric group (n=9)	p-value
Age(year)	45 to 70 years		-
Sex (%)	(66.7%) males and (33.3%) females		-
DM	11(45.8%)		-
HTN	20(83.8%)		-
Dyslipidemia	24(100%)		-
Smoking	17(70.8%)		-
Family history of premature coronary artery diseases	54.2%		-
Previous myocardial infarction Anterior Inferior	 15 patients (62.5%) 9patient (37.5%)		-
Hemodynamic data HR systolic blood pressure diastolic blood pressure	 mean value 69.21 ± 5.96 mean value 126.67 ± 12.74 mmHg with mean value 83.33 ± 6.70 mmHg		-
NYHA function class			p-value
I	3	4	ns
II	9	4	ns
III	3	1	ns

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Global LV dimension and function:

The patients with ischemic mitral regurgitation showed differences in all indexes of global LV remodeling (Table 2). Comparing the two groups of patients, global Left Ventricle Function: Wall motion score index was higher in the symmetric than asymmetric group, ($p > 0.05$). While in LV end-diastolic and end-systolic dimensions and left ventricle ejection fraction (%) higher in asymmetrical group than symmetrical group ($p > 0.05$). Also there were no significant differences between two groups regarding left ventricle volumes ($p > 0.05$) (Table 2).

Degree of mitral regurgitation

The transthoracic echo study of the regurgitant jet showed that in the asymmetric group increase in regurgitant volume, EROA (cm) and Vena Contracta so increase the degree of mitral regurgitation (Table 2).

Mitral deformation indexes

Patients with symmetric tethering exhibited significantly greater mitral valve deformation indices than those with asymmetric tethering, reflecting more advanced geometric distortion of the mitral apparatus. (Table 2).

Mitral inflow doppler assessment:

in our study, no significant differences were observed between the symmetric and asymmetric groups regarding E-wave velocity, A-wave velocity, E/Ea ratio, or deceleration time. (Table 2).

Table (2) Global LV dimension and function, degree of mitral regurgitation and mitral deformation indexes.

	Mechanism		**p-value**
	Symmetric group(n=15)	**Asymmetric group(n=9)**	
Global LV remodeling and function			
WMSI	1.54±0.21	1.52±0.28	($p > 0.05$)
LVEDD(mm)	63.40±6.58	65.89±6.64	($p > 0.05$)
LVESD(mm)	52.13 ± 6.79	52.89±5.46	($p > 0.05$)
EDV (ml)	206.33 ± 46.89	224.78 ± 50.51	($p > 0.05$)
ESV (ml)	124.67 ± 36.68	142.67 ± 31.21	($p > 0.05$)
EF (%)	34.80 ± 6.94	38.56 ± 5.50	($p > 0.05$)
Degree of mitral regurgitation			
RJ area(cm^2)	4.73 ± 2.42	6.98 ± 3.35	($p > 0.05$)
Left atrial area(cm^2)	18.81 ± 4.49	19.62 ± 4.55	($p > 0.05$)
RJA: LTA area ratio %	23.60 ± 9.77	34.11 ± 14.36	($p > 0.05$)
VC(cm)	0.43 ± 0.13	0.54 ± 0.20	($p > 0.05$)
PISA(ml)	82.26 ± 77.78	183.78 ± 123.14	$^{t}p=0.046^{*}$
EROA(cm)	0.18 ± 0.13	0.39 ± 0.23	$^{Z}p= 0.025^{*}$
RG Volume(ml)	26.65 ± 20.72	58.22 ± 36.37	$^{Z}p=0.022^{*}$
Mitral regurgitation fraction (%)	23.69 ± 12.29	38.22 ± 16.0	$^{Z}p=0.018^{*}$
Mitral deformation indexes			
Coaptation height (mm)	13.63 ± 1.82	12.48 ± 2.18	$^{Z}p=0.001^{*}$
Tenting area (cm2)	3.63 ± 0.44	3.40 ± 0.51	$^{t}p=0.002^{*}$
MA area (cm2)	11.93 ± 0.87	11.40 ± 1.03	$^{t}p<0.001^{*}$
LVdiastolic function			
E wave m/s	0.66 ± 0.31	0.54 ± 0.33	$^{Z}p=0.340$
A wave m/s	0.60 ± 0.19	0.49 ± 0.13	$^{t}p=0.129$
E/A ratio	1.58 ± 0.73	1.67 ± 0.81	$^{t}p=0.784$
Deceleration time (msec)	156.33 ± 50.76	178.22 ± 49.44	$^{t}p=0.313$

In the present study, mitral annular tissue doppler systolic and diastolic mitral velocities were taken in six aspects for all patients.

Systolic function of the left ventricle by tissue doppler imaging

The mean systolic myocardial velocity (Sws) measured at the lateral, anterior, and Anteroseptal walls was lower in the symmetric group compared with the asymmetric group; however, these differences were not statistically significant (Table 3). In contrast, mean Sws values at the septal, inferior, and posterior walls tended to be lower in the asymmetric group than in the symmetric group, without reaching statistical significance (Table 3).

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Diastolic function of the left ventricle by tissue doppler imaging:
Assessment of diastolic function showed no significant differences between the symmetric and asymmetric groups with respect to early diastolic (Em) velocity, late diastolic (Am) velocity, or the E/Em ratio. Nevertheless, pulsed tissue Doppler imaging demonstrated reduced diastolic myocardial velocities in ischemic regions compared with non-ischemic segments, irrespective of tethering pattern (Table 3).

Correlation between Mitral Regurgitation Severity and Mitral Valve Geometry
Correlation analysis revealed a weak inverse relationship between mitral regurgitation fraction and coaptation height, tenting area, and mitral annular area; however, these associations did not reach statistical significance ($p > 0.05$).

Table (3) mitral annular tissue doppler systolic and diastolic velocities.

Mitral annulus tissue doppler	Mechanism		p ANOVA
	Symmetric group(n=15)	asymmetric group(n=9)	
Lateral wall			
Sa m/s	0.11 ± 0.10	0.15 ± 0.20	0.929
Ea m/s	0.16 ± 0.23	0.17 ± 0.21	0.952
Aa m/s	0.11 ± 0.14	0.14 ± 0.21	0.835
E/Ea ratio cm/s	4.53 ± 3.60	4.25 ± 3.14	0.848
Septum			
Sa m/s	0.08 ± 0.02	0.07 ± 0.02	0.382
Ea m/s	0.08 ± 0.02	0.09 ± 0.05	0.720
Aa m/s	0.08 ± 0.03	0.09 ± 0.02	0.595
E/Ea ratio cm/s	6.48 ± 5.01	5.51 ± 3.99	0.655
LV Anterior wall			
Sa m/s	0.08 ± 0.03	0.14 ± 0.17	0.551
Ea m/s	0.10 ± 0.03	0.19 ± 0.29	0.046*
Aa m/s	0.11 ± 0.09	0.12 ± 0.03	0.244
E/Ea ratio cm/s	4.79 ± 4.58	5.26 ± 3.66	0.042*
LV inferior wall			
Sa m/s	0.14 ± 0.18	0.08 ± 0.04	0.456
Ea m/s	0.16 ± 0.23	0.09 ± 0.05	0.244
Aa m/s	0.18 ± 0.23	0.07 ± 0.04	0.310
E/Ea ratio cm/s	5.78± 4.63	5.15 ± 3.18	0.811
LV posterior wall			
Sa m/s	0.09 ± 0.03	0.08 ± 0.04	0.064
Ea m/s	0.13 ± 0.18	0.09 ± 0.05	0.765
Aa m/s	0.21 ± 0.25	0.09 ± 0.03	0.371
E/Ea ratio cm/s	5.63 ± 4.35	5.19 ± 3.79	0.720
LV Anteroseptal wall			
Sa m/s	0.07 ± 0.03	0.09 ± 0.04	0.455
Ea m/s	0.08 ± 0.07	0.09 ± 0.04	0.245
Aa m/s	0.07 ± 0.3	0.10 ± 0.02	0.016*
E/Ea ratio cm/s	7.25 ± 4.37	5.36 ± 3.82	0.654

Discussion
This study reinforces that IMR is a heterogeneous condition, with symmetric and asymmetric leaflet tethering presenting distinct patterns of LV remodeling and MR severity.

Symmetric tethering is commonly associated with anterior MI and diffuse LV dysfunction, leading to increased leaflet tenting and mitral annular dilation. Conversely, asymmetric tethering is typically linked to inferior MI and results in posterior displacement of papillary muscles with more severe MR despite relatively preserved LV size. Our findings align with previous studies demonstrating that MR severity is not solely dependent on global LV function but is strongly influenced by the geometry of the mitral valve apparatus. TDI measurements further illustrate the correlation between regional systolic dysfunction and annular motion, reinforcing the diagnostic value of tissue Doppler in IMR assessment.

Global and local LV remodeling
Functional mitral regurgitation is primarily driven by systolic mitral valve tenting, which reflects local left ventricular remodeling, particularly apical and posterior displacement of the papillary muscles. In contrast, global left ventricular size and systolic performance appear to have a limited influence on the severity of mitral regurgitation and the extent of leaflet tethering.

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In the present study, global left ventricular function assessed by wall motion score index was higher in patients with symmetric tethering compared with those with asymmetric tethering; however, this difference did not reach statistical significance. Left ventricular end-diastolic and end-systolic dimensions, as well as ejection fraction, tended to be higher in the asymmetric group, with no significant differences observed between the two groups regarding left ventricular volumes.

These findings are partially consistent with previous reports. Gelsomino et al.,(2013) demonstrated that patients with symmetric tethering exhibited significantly larger left ventricular dimensions and volumes, along with worse global systolic function. (5) Conversely, Agricola et al., (2004) and Dudzinski et al., (2014) reported smaller ventricular dimensions and volumes with relatively preserved ejection fraction in patients with asymmetric tethering.(6)((7) Similar observations were described by Zeng et al.,(2014) who showed that symmetric tethering was associated with more advanced ventricular remodeling, lower ejection fraction, and higher wall motion score indices. (8)(9)

Degree of mitral regurgitation

Echocardiographic assessment revealed that patients with asymmetric tethering exhibited larger regurgitant volumes, increased effective regurgitant orifice area, and wider vena Contracta, indicating more severe mitral regurgitation. These findings suggest that asymmetric leaflet tethering may exacerbate regurgitation severity despite relatively preserved global ventricular function table (2).

Supporting this concept, Zeng et al.,(2014) reported that asymmetric tethering was associated with increased mitral regurgitation severity, larger vena Contracta width, and higher effective regurgitant orifice area, despite higher ejection fraction and less extensive wall motion abnormalities. (8) In contrast, Gelsomino et al.,(2013) observed greater regurgitant parameters in patients with symmetric tethering, (5) while Zito et al.,(2013) demonstrated a significantly larger effective regurgitant orifice area in the asymmetric group. These discrepancies highlight the complex interaction between ventricular geometry and mitral valve deformation in ischemic mitral.

Mitral deformation indexes

In this study, indices of mitral valve deformation were significantly more pronounced in patients with symmetric tethering table (2). Previous investigations have similarly shown that symmetric tethering is associated with increased coaptation height and tenting area, reflecting more advanced leaflet displacement. While Agricola et al.,(2004) and Zeng et al.,(2014) reported a larger annular area in asymmetric tethering, (6)(8) Dudzinski et al.,(2014) found that both annular area and tenting area were greater in symmetric patter. (7) Collectively, these findings emphasize that symmetric remodeling is characterized by more extensive geometric distortion of the mitral apparatus.

Mitral inflow Doppler assessment:

Mitral inflow Doppler parameters, including E-wave velocity, A-wave velocity, E/Ea ratio, and deceleration time, did not differ significantly between symmetric and asymmetric tethering patterns in the current study. These observations are in agreement with previous data reported by Zito et al.,(2013) who demonstrated comparable diastolic filling indices between the two groups.(10)

In the present study mitral annular tissue doppler systolic and diastolic mitral velocities were taken in six aspects for all patients. (Table 3).

Tissue Doppler imaging revealed regional differences in systolic myocardial velocities. In symmetric tethering, systolic velocities were relatively reduced at the lateral, anterior, and anteroseptal walls, whereas in asymmetric tethering, lower velocities were more evident at the septal, inferior, and posterior walls. These findings are consistent with prior studies **Alam** et al.,(2000) , **Bountiouk** et al.,(2004) **and Yamada** et al.,(1998) showing reduced systolic velocities in ischemic myocardial segments, reflecting regional contractile dysfunction. (11) (12) (13)

Assessment of diastolic function using tissue Doppler imaging showed no significant differences in early or late diastolic velocities or E/Em ratio between the two groups. Nevertheless, diastolic myocardial velocities were consistently lower in ischemic regions compared with non-ischemic segments. This observation aligns with previous studies Derumeaux et al.,(1998) , **Elzaky** et al.,(2004) **and Carlos** et al.,(1999) demonstrating impaired diastolic relaxation in ischemic myocardium, even in the absence of significant global diastolic dysfunction. .(14) (15),(16)

Conclusion

Echocardiographic assessment of tethering patterns offers significant insight into the mechanisms and severity of ischemic MR. Symmetric and asymmetric IMR represent distinct phenotypes, each with characteristic patterns of LV remodeling, mitral leaflet deformation, and regurgitation severity. Tissue Doppler imaging provides additional value by identifying regional myocardial dysfunction and aiding in global LV functional assessment.

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Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

REFERENCES

1. Grigioni F, Enriquez-Sarano M, Zehr KJ, Bailey KR, Tajik AJ. Ischemic mitral regurgitation: long-term outcome and prognostic implications with quantitative Doppler assessment. Circulation. 2001;103:1759–64.
2. Lamas GA, Mitchell GF, Flaker GC, Smith SC, Gersh BJ, Basta L, et al. Clinical significance of mitral regurgitation after acute myocardial infarction. Survival and Ventricular Enlargement Investigators. Circulation. 1997;96:827–33.
3. Otsuji Y, Kumanohoso T, Yoshifuku S, Matsukida K, Koriyama C, Kisanuki A, et al. Isolated annular dilation does not usually cause important functional mitral regurgitation: comparison between patients with lone atrial fibrillation and those with idiopathic or ischemic cardiomyopathy. J Am Coll Cardiol. Am Coll Cardio Found; 2002;39:1651–6.
4. Yiu SF, Enriquez-Sarano M, Tribouilloy C, Seward JB, Tajik AJ. Determinants of the degree of functional mitral regurgitation in patients with systolic left ventricular dysfunction a quantitative clinical study. Circulation. Am Heart Assoc; 2000;102:1400–6.
5. Gelsomino S, Van Garsse L, Lucà F, Parise O, Cheriex E, Rao CM, et al. Left ventricular strain in chronic ischemic mitral regurgitation in relation to mitral tethering pattern. J Am Soc Echocardiogr. 2013;26.
6. Agricola E, Oppizzi M, Maisano F, De Bonis M, Schinkel AFL, Torracca L, et al. Echocardiographic classification of chronic ischemic mitral regurgitation caused by restricted motion according to tethering pattern. Eur J Echocardiogr. 2004;5:326–34.
7. Dudzinski DM, Hung J. Echocardiographic assessment of ischemic mitral regurgitation. Cardiovasc Ultrasound. 2014;12:46.
8. Zeng X, Nunes MCP, Dent J, Gillam L, Mathew JP, Gammie JS, et al. Asymmetric versus symmetric tethering patterns in ischemic mitral regurgitation: Geometric differences from three-dimensional transesophageal echocardiography. J Am Soc Echocardiogr. 2014;27:367–75.
9. Zeng X, Tan TC, Dudzinski DM, Hung J. Echocardiography of the Mitral Valve. Prog Cardiovasc Dis. 2014;57:55–73.
10. Zito C, Cusmà-Piccione M, Oreto L, Tripepi S, Mohammed M, Di Bella G, et al. In patients with post-infarction left ventricular dysfunction, how does impaired basal rotation affect chronic ischemic mitral regurgitation? J Am Soc Echocardiogr. 2013;26:1118–29.
11. Alam M, Wardell J, Andersson E, Samad B a., Nordlander R. Effects of first myocardial infarction on left ventricular systolic and diastolic function with the use of mitral annular velocity determined by pulsed wave doppler tissue imaging. J Am Soc Echocardiogr. 2000;13:343–52.
12. Bountioukos M. Pulsed wave tissue Doppler imaging for the quantification of contractile reserve in stunned, hibernating, and scarred myocardium. Heart. 2004;90:506–10.
13. Yamada E, Garcia M, Thomas JD, Marwick TH. Myocardial Doppler velocity imaging - A quantitative technique for interpretation of dobutamine echocardiography. Am J Cardiol. 1998;82:806–9.
14. Derumeaux G, Ovize M, Loufoua J, André-Fouet X, Minaire Y, Cribier a, et al. Doppler tissue imaging quantitates regional wall motion during myocardial ischemia and reperfusion. Circulation. 1998;97(19):1970–7.
15. El-Zaki M M, Abu-El-Enin W M, Al-Cekelly MM TO. Assessment of regional diastolic dysfunction in coronary artery disease detected by tissue Doppler during dobutamine stress echocardiography. 2004;116.
16. Farias C a, Rodriguez L, Garcia MJ, Sun JP, Klein a L, Thomas JD. Assessment of diastolic function by tissue Doppler echocardiography: comparison with standard transmitral and pulmonary venous flow. J Am Soc Echocardiogr. 1999;12:609–17.

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