Underestimation of severity of mitral regurgitation with varying hemodynamics

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Abstract
Transesophageal echocardiography (TEE) is a valuable technique to assess mitral valve anatomy and the mechanism of mitral regurgitation (MR). We present the case of a 35-year-old woman with severe MR due to restrictive motion of the posterior mitral leaflet, who was referred for mitral annuloplasty. Under physiologic circumstances, a severe (grade 3+) MR was present, whereas in the operating room during general anesthesia, the MR had disappeared almost completely. The downgrading of MR due to general anesthesia and the associated mechanisms of this phenomenon are discussed in this case.

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Case report
A 35-year-old woman with congestive heart failure underwent transesophageal echocardiography (TEE) for pre-operative assessment of evaluation of the severity and mechanism of mitral regurgitation (MR) at the outpatient clinic. Her medical history revealed a Wilms' tumor at the age of 2 years, treated by nephrectomy and adjuvant chemotherapy and local radiotherapy. Two years later she has been treated again with radiotherapy because of left-sided lung metastases.

Five years ago a DDD-R pacemaker was implanted because of a total AV-block. Over the last years she has stable (NYHA class II) congestive heart failure due to a diminished left ventricular function (ejection fraction 25%) with moderate MR and pulmonary hypertension (mean pulmonary artery pressure 50–60 mmHg). Because of increasing dyspnea (NYHA class III), transthoracic

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Echocardiography was performed and demonstrated a non-dilated left ventricle with moderate function (LVEDD 50 mm, LVESD 36 mm, LVEF 25%); color Doppler echocardiography revealed a grade 3+ MR. Further evaluation demonstrated systolic restriction of the posterior mitral leaflet, resulting in malcoaptation and a grade 3+ MR, best fitting type IIIB according to Carpentier’s classification.\(^1\)

Multiplane TEE confirmed the severe (grade 3+) mitral regurgitation due to restrictive motion of the posterior leaflet; the left ventricular annulus measured 29 mm (measured at a 0° 4-chamber view, normal value < 40 mm), with an anterior mitral leaflet of 26 mm and a coaptation distance of 4 mm (normal value > 7 mm) (Fig. 1). Angiography excluded coronary artery disease. Accordingly, the patient was scheduled for restrictive mitral annuloplasty. During general anesthesia an intraoperatively performed TEE showed a relatively hypovolemic left ventricle with a significant reduction in mitral annular size (25 mm) and MR (grade 1+) (Fig. 2). After a preload test, by rapid infusion of volume until the pulmonary artery capillary wedge pressure reached 15 mmHg, the severity of MR was grade 3+ (Fig. 3).

Stringent restrictive mitral annuloplasty was subsequently performed and a size 24 Physio-Ring (Carpentier–Edwards Physio Annuloplasty Ring; Baxter–Edwards Laboratories, Irvine, CA) was implanted. The procedure was uncomplicated. Control echocardiography in the operating room excluded residual MR with a coaptation distance of 8 mm (Fig. 4). Six months after surgery the patient had improved in symptoms (NYHA class I–II). Repeat transthoracic echocardiography showed no residual MR, preserved coaptation and a LVEF of 49%.

**Discussion**

The assessment of MR in congestive heart failure is complex and interpretation can be hampered by its dynamic nature. As illustrated in this case, the severity may change significantly with varying hemodynamic circumstances. In the current report, a grade 3+ MR (Carpentier type IIIB) was demonstrated by transthoracic echocardiography and TEE under physiologic circumstances. This is frequently observed in ischemic MR or in dilated cardiomyopathy, but in this patient may have been secondary to the previous radiation therapy. Under general anesthesia and hypovolemia, the MR had reduced dramatically to grade 1+. Different studies report dramatic downgrading for all etiologies of MR except flail leaflet due to ruptured chordae.\(^2\) The mechanism underlying this phenomenon is almost certainly the unloading effect of general anesthesia. It is observed more often in patients presenting with MR secondary to ischemic heart disease or *dilated cardiomyopathy* (frequently with systolic restriction, type IIIb MR) with or without annular dilatation, these types of MR are predominantly susceptible to changes in hemodynamics including hypovolemia resulting in reduction of annular dimensions. In addition, arterial

![Figure 1](https://academic.oup.com/ehjcimaging/article-abstract/6/4/297/2397792/298 A.J.H.A. Scholte et al.)

**Figure 1** Pre-operative transesophageal 4-chamber view showing grade 3+ MR at the outpatient clinic.
and venous vasodilatations decrease afterload and preload, respectively. Grewal et al. reported a significant reduction in parameters of MR severity in 22 of 43 patients (51%) under general anesthesia resulting in a significant reduction in blood pressure and LV cavity dimensions. Eleven patients (26%) had a reduction from 3–4+ preoperatively, to 1–2+ in the operating room. Particularly in patients undergoing coronary artery bypass surgery with moderate MR it is frequently unclear whether concomitant mitral valve repair is needed. In a retrospective study by Aklog et al., in which 136 patients with a pre-operative diagnosis of moderate ischemic MR underwent isolated CABG alone, 40% of patients continued to have at least moderate (3–4+) MR, whereas 51% improved to mild (2+) and only 9% had resolution of the MR (0–1+).

Figure 2  Transesophageal 4-chamber view showing significant downgrading of the severity of MR during general anesthesia.

Figure 3  Transesophageal 4-chamber view after the preload test, showing grade 3+ MR.
In the current patient, the severity of the MR was assessed under physiological circumstances before entering the operating room. In those patients in whom the unloading effects of general anesthesia may have downgraded MR and the precise severity is unclear, provocative testing under TEE guidance before the start of the operation may help resolve the problem and determine whether mitral valve repair is indicated. Byrne and colleagues reported these procedures.\(^4,5\) A preload test can be done by rapid transfusion of volume until the pulmonary artery capillary wedge pressure reaches 15–18 mmHg. Alternatively, an afterload challenge can be done with intravenous phenylephrine bolus injection until the mean arterial pressure reaches about 100 mmHg. After these hemodynamic interventions, the severity of MR is re-evaluated with TEE, and adequate decisions can be made whether to perform CABG alone or in combination with a mitral valve annuloplasty.

**Conclusion**

This case report illustrates that compared with pre-operative assessment, a significant reduction in severity of MR can be observed in the operating room due to major changes in hemodynamics and loading conditions.

In patients with ischemic mitral regurgitation or *dilated cardiomyopathy* a pre-operative echocardiographic evaluation is thus preferred under physiological circumstances to evaluate and appreciate the severity and mechanism of the MR. If the severity of the MR is unclear and the only possibility to analyze is in the operating room during general anesthesia, provocative testing should be included to guide management in terms of performing mitral valve repair or not.

**References**


