Management of asymptomatic patients with severe non-ischaemic mitral regurgitation. Are practices consistent with guidelines?

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Abstract

Objective: For asymptomatic patients with severe mitral regurgitation, guidelines recommend surgery in selected patients. However, little is known on how the current practice fits with guidelines.

Methods: Of the 5001 patients prospectively included in the Euro Heart Survey on valvular heart disease, 877 had isolated mitral regurgitation and 546 had severe mitral regurgitation (grade ≥3/4 with Doppler echocardiography). Of them, 101 were asymptomatic and had non-ischaemic mitral regurgitation. The decision to refer the patients to surgery or not operate was analysed by comparing patient characteristics with American College of Cardiology/American Heart Association guidelines.

Results: Coronary angiography was performed in 21 out of 33 patients (64%) who were considered for surgery. Catheterisation was performed in 27 patients (27%). A decision to operate was taken in 33 patients (33%). Decisions to refer to surgery or not were in accordance with guidelines in 63 patients (62%). Regarding discordant decisions, intervention was considered ‘over-used’ in 9 patients (9%) and ‘under-used’ in 29 patients (29%), of whom 24 had a class I or IIa indication for surgery. Of the 68 non-operated patients, 44 (65%) received at least one drug with haemodynamic effect.

Conclusions: In asymptomatic patients with severe mitral regurgitation, preoperative coronary angiography seems under-used and cardiac catheterisation is frequently used. Regarding the decision to operate or not, a large number of patients were not referred to surgery even though they fulfilled recommendation for surgery. Thus, to avoid too late surgical referral, implementation of existing guidelines should be improved.

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Keywords: Mitral regurgitation; Valvular surgery; Guidelines

1. Introduction

Mitral regurgitation is the second most frequent single native valve disease in industrialised countries after aortic stenosis [1—3]. Advances in echocardiographic evaluation of mitral valve disease have led to the diagnosis and management of mitral regurgitation in an increasing number of asymptomatic patients. Improvement of surgical techniques, in particular valve repair, has resulted in improved outcomes, thus favouring a trend toward earlier surgery [4—7]. However, the management of severe asymptomatic mitral regurgitation remains controversial [8]. Moreover, there is no data on how the current clinical practice fits with guidelines.

The aim of the present study is to evaluate contemporary management of asymptomatic patients with severe non-ischaemic mitral regurgitation and compare it with the available recommendations on the management of valvular heart disease, in particular as regards the decision to refer the patient to surgery or not. For this purpose, we used the data from the Euro Heart Survey on valvular heart disease, which was designed to evaluate current practices.

2. Materials and methods

2.1. Patient population

The Euro Heart Survey on valvular heart disease included 5001 patients who were prospectively recruited in 92 centres across 25 European countries between April and July 2001. Patients were included if they had moderate or severe native valve disease according to transthoracic echocardiography,
probable or definite infective endocarditis, or who had previous valve intervention. Detailed information on the patient population, criteria for patient selection, definition of variables and data collection has been previously described [1]. Isolated mitral regurgitation was defined by a grade ≥2/4 mitral regurgitation without significant associated valve disease, i.e. without aortic stenosis with a maximum aortic velocity as assessed by Doppler echocardiography ≥2.5 m/s, aortic regurgitation grade ≥2/4, and mitral stenosis with a valve area <2 cm². Severe mitral regurgitation was defined by a grade ≥3/4 as assessed by Doppler echocardiography. Ischaemic mitral regurgitation was defined by the association of mitral regurgitation related to restricted motion of the leaflets without structural abnormality, as assessed by echocardiography, and significant coronary artery disease. Non-ischaemic mitral regurgitation was defined by the association of structural impairment of the valvular and/or subvalvular apparatus.

Patients were classified as asymptomatic when they were in New York Heart Association (NYHA) class I and had no angina.

2.2. Analysis of concordance with guidelines

The actual decision to refer the patient to surgery or not was compared with the recommendations of the 1998 issue American College of Cardiology/American Heart Association (ACC/AHA) guidelines [9], which were the only international guidelines available at the time of the survey. Management was considered to be in accordance with guidelines when (1) there was a decision to operate in patients whose preoperative characteristics corresponded to a class I or II recommendation for intervention, or (2) when surgery was not planned in patients without such characteristics, or in patients with a class I or II recommendation but with at least one comorbidity. A high likelihood of valve repair was defined by mitral regurgitation of degenerative origin and related to posterior leaflet prolapse.

Intervention was defined as ‘over-used’ when it was planned in patients with no characteristics for class I or II recommendations, and ‘under-used’ when it was not planned in patients who had the required criteria for either class I or II recommendations for surgery and no comorbidities.

2.3. Statistical analysis

Quantitative variables were expressed as mean ± standard deviation and qualitative variables as percentages. Comparisons between subgroups used the unpaired Student’s t-test for quantitative variables and the chi square test for qualitative variables. The significance of the comparison between guidelines and actual practices was assessed using the McNemar chi square test. All tests were two-sided. A p value < 0.05 was considered significant. Analysis was performed using SAS statistical software (SAS Institute Inc, release 8.2).

3. Results

3.1. Population

Of the 5001 patients included in the Euro Heart Survey, 877 had isolated mitral regurgitation, of whom 546 had severe mitral regurgitation. Among patients with severe mitral regurgitation, 103 were asymptomatic. Finally, 101 patients were asymptomatic and had non-ischaemic mitral regurgitation and form the population of the present study (Fig. 1).

Inclusion site was an outpatient clinic in 58 patients (57%), a medical department in 29 (29%), and a surgical department in 14 (14%). Thirty-five patients (35%) were included in countries from Western, 23 (23%) in Eastern, 38 (37%) in Mediterranean, and 5 (5%) in Northern Europe. Valvular heart disease was previously known in 77 (76%) patients. Patient characteristics are shown in Table 1. Overall, 21 patients (21%) had at least one comorbidity. Surgery was advised by the referring physician in 33 patients (33%) and decided against in 68 (67%) patients.

3.2. Investigations

All patients had transthoracic echocardiography since it was required for survey inclusion. Mitral regurgitation was graded 3/4 in 77 (76%) patients and graded 4/4 in 24 (24%)

<table>
<thead>
<tr>
<th>Clinical characteristics of the 101 asymptomatic patients with severe non-ischaemic mitral regurgitation</th>
<th>Mean ± SD or n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>62 ± 16</td>
</tr>
<tr>
<td>Gender (female)</td>
<td>37 (37)</td>
</tr>
<tr>
<td>Aetiology</td>
<td></td>
</tr>
<tr>
<td>Degenerative</td>
<td>68 (67)</td>
</tr>
<tr>
<td>Rheumatic</td>
<td>8 (8)</td>
</tr>
<tr>
<td>Endocarditis</td>
<td>8 (8)</td>
</tr>
<tr>
<td>Congenital</td>
<td>8 (8)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (8)</td>
</tr>
<tr>
<td>Risk factors</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>37 (37)</td>
</tr>
<tr>
<td>Smoking</td>
<td>15 (15)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>9 (9)</td>
</tr>
<tr>
<td>Hyperlipidaemia</td>
<td>32 (32)</td>
</tr>
<tr>
<td>Comorbidity</td>
<td></td>
</tr>
<tr>
<td>Previous myocardial infarction</td>
<td>11 (11)</td>
</tr>
<tr>
<td>Carotid artery disease</td>
<td>0</td>
</tr>
<tr>
<td>Lower limbs atherosclerosis</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>9 (9)</td>
</tr>
<tr>
<td>Serum creatinine &gt;200 μmol/l</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Neurological dysfunction</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>
patients. The cardiac consequences of mitral regurgitation are detailed in Table 2.

Overall transoesophageal echocardiography was performed in 24 (24%) patients. Of the 33 patients referred to surgery, preoperative transoesophageal echocardiography was performed in 14 (42%). Only nine patients (9%) had a stress test, which was an exercise electrocardiogram in six cases. No patients had exercise echocardiography. Among invasive investigations, 27 (27%) patients underwent cardiac catheterisation, which was right catheterisation only in 2 (2%), left only in 8 (8%), and both left and right in 17 (17%). Cardiac catheterisation was always associated with coronary angiography. Coronary angiography was performed in 32 patients (32%) and showed significant lesions in 9 patients, representing 28% of cases.

When considering the 33 patients referred to surgery, 21 (64%) had coronary angiography. Twelve patients did not have preoperative coronary angiography, 10 of whom should have had it given their age and/or the presence of cardiovascular risk factors. Difference between guidelines and actual performance of coronary angiography in the 33 patients referred to surgery was significant (p = 0.0016).

3.3. Referral to surgery and concordance with guidelines

The concordance between the ACC/AHA criteria for intervention and the characteristics of the study population is given in Table 3.

(1) The actual management was in accordance with the recommendations in 63 patients (62%):

1. 24 were referred to surgery and who fulfilled the criteria for a class I (2 patients), IIa (14 patients) or IIb (8 patients) recommendation for intervention,
2. 14 who were not referred to surgery, despite class I or II criteria for intervention, when at least one comorbidity was present. Comorbidities were, either singly or in combination, chronic pulmonary disease in 6 patients, previous myocardial infarction in 4, coronary artery disease in 4, non-cardiac atherosclerosis in 4, and neurological dysfunction in 1.
3. 25 who were not referred to surgery and had no criteria for intervention.

2. Decisions were discordant with the guidelines in 38 patients (38%).

1. Intervention was considered 'under-used' in 29 patients (29%) who were not referred to surgery although they had no comorbidity and fulfilled the criteria for surgery: class I recommendation in 4 patients and IIa in 20, because of left ventricular dysfunction and/or atrial fibrillation, and IIb in 5 in whom valve repair was highly likely.

Table 2
Electrocardiographic and echocardiographic findings in the 101 asymptomatic patients with severe non-ischaemic mitral regurgitation

<table>
<thead>
<tr>
<th>Atrial fibrillation</th>
<th>Mean ± SD or n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left ventricular end-diastolic dimension (mm)</td>
<td>58 ± 7</td>
</tr>
<tr>
<td>Indexed left ventricular end-diastolic dimension (mm/m² BSA)</td>
<td>32 ± 4</td>
</tr>
<tr>
<td>Left ventricular end-systolic dimension (mm)</td>
<td>37 ± 6</td>
</tr>
<tr>
<td>Indexed left ventricular end-systolic dimension (mm/m² BSA)</td>
<td>20 ± 3</td>
</tr>
<tr>
<td>Left ventricular septum thickness (mm)</td>
<td>10 ± 2</td>
</tr>
<tr>
<td>Left ventricular posterior wall thickness (mm)</td>
<td>10 ± 2</td>
</tr>
<tr>
<td>Left ventricular ejection fraction (%)</td>
<td>59 ± 12</td>
</tr>
<tr>
<td>Left atrial dimension (mm)</td>
<td>47 ± 8</td>
</tr>
</tbody>
</table>

BSA: body surface area.

Table 3
Concordance between ACC/AHA recommendation class and actual decision in the 101 asymptomatic patients with severe non-ischaemic mitral regurgitation

<table>
<thead>
<tr>
<th>Decision to operate and operation recommended</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision not to operate and operation recommended</td>
<td>24</td>
</tr>
</tbody>
</table>

According to guidelines

- Class I
  - Mild LV dysfunction (EF 0.50–0.60 and ESD 45–50 mm)
  - Moderate LV dysfunction (EF 0.30–0.50 and/or ESD 50–55 mm)
- Class IIa
  - Preserved LV function and atrial fibrillation
  - Preserved LV function and pulmonary hypertension
- Class IIb
  - LV dysfunction (EF <0.30 and/or ESD >55 mm)
  - LV dysfunction (EF <0.60 and ESD 45–55 mm)

Concordant decisions 63

- Decision to operate and operation recommended
- Decision not to operate and operation not recommended

Discordant decisions 38

- Decision to operate and operation recommended
- Decision not to operate and operation not recommended

L V: left ventricle; EF: ejection fraction; ESD: end-systolic dimension.

* The total may exceed the sum of all criteria since several criteria can be present in a patient.

<table>
<thead>
<tr>
<th>Decision to operate and operation not recommended</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decision to operate and operation not recommended</td>
<td>14</td>
</tr>
</tbody>
</table>

According to guidelines, without comorbidity

- Class I
  - Mild LV dysfunction (EF 0.50–0.60 and ESD 45–50 mm)
  - Moderate LV dysfunction (EF 0.30–0.50 and/or ESD 50–55 mm)
- Class IIa
  - Preserved LV function and atrial fibrillation
  - Preserved LV function and pulmonary hypertension
- Class IIb
  - LV dysfunction (EF <0.30 and/or ESD >55 mm) in whom chordal preservation is highly likely

Decision to operate and operation not recommended

- Class I
  - Mild LV dysfunction (EF 0.50–0.60 and ESD 45–50 mm)
  - Moderate LV dysfunction (EF 0.30–0.50 and/or ESD 50–55 mm)
- Class IIa
  - Preserved LV function and atrial fibrillation
  - Preserved LV function and pulmonary hypertension
- Class IIb
  - LV dysfunction (EF <0.30 and/or ESD >55 mm) in whom chordal preservation is highly likely

Decision to operate and operation not recommended

- Class I
  - Mild LV dysfunction (EF 0.50–0.60 and ESD 45–50 mm)
  - Moderate LV dysfunction (EF 0.30–0.50 and/or ESD 50–55 mm)
- Class IIa
  - Preserved LV function and atrial fibrillation
  - Preserved LV function and pulmonary hypertension
- Class IIb
  - LV dysfunction (EF <0.30 and/or ESD >55 mm) in whom chordal preservation is highly likely

Decision to operate and operation not recommended

- Class I
  - Mild LV dysfunction (EF 0.50–0.60 and ESD 45–50 mm)
  - Moderate LV dysfunction (EF 0.30–0.50 and/or ESD 50–55 mm)
- Class IIa
  - Preserved LV function and atrial fibrillation
  - Preserved LV function and pulmonary hypertension
- Class IIb
  - LV dysfunction (EF <0.30 and/or ESD >55 mm) in whom chordal preservation is highly likely
2. On the other hand, intervention was considered 'over-used' in nine patients (9%) who were referred to surgery in the absence of class I, IIa or IIb criteria. Mean left ventricular end-systolic dimension was 36 ± 5 mm in these nine patients and three of them had end-systolic dimension between 40 and 45 mm.

Difference between the recommendations from guidelines and actual decision to operate or not was significant ($p = 0.0012$). Distribution of European region ($p = 0.69$), site of inclusion ($p = 0.56$) and age ($p = 0.09$) did not differ between the 63 patients with a concordant decision and the 38 patients with a discordant decision.

3.4. Modalities of surgery

During the survey period 18 patients were actually operated on in a centre participating in the Euro Heart Survey. Valve replacement was performed in 7 patients (6 with a mechanical prosthesis, 1 with a bioprosthesis) and valve repair in 11 patients. Coronary artery bypass grafting was associated in three patients. No operative death was observed. One-year survival was 100% in operated patients.

3.5. Medical therapy

In the 68 patients in whom surgery was decided against, medical therapy was frequently used (Table 4). Forty-four of them (65%) received at least one drug with haemodynamic effect, i.e. diuretics, ACE-inhibitors, calcium blockers, nitrates, or beta-blockers. Even in the 40 patients who were denied surgery and who did not have hypertension, 21 (53%) received at least one drug with haemodynamic effect.

Prophylaxis of endocarditis was studied in the 77 patients observed. One-year survival was 100% in operated patients.

Table 4
Medical therapy in the patients for whom the decision was not to operate

<table>
<thead>
<tr>
<th></th>
<th>All patients (n = 68)</th>
<th>Normotensive patients (n = 40)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Aspirin</td>
<td>21 (31)</td>
<td>9 (23)</td>
</tr>
<tr>
<td>Anticoagulants</td>
<td>13 (19)</td>
<td>10 (25)</td>
</tr>
<tr>
<td>Diuretics</td>
<td>18 (27)</td>
<td>7 (18)</td>
</tr>
<tr>
<td>Digoxin</td>
<td>9 (13)</td>
<td>4 (10)</td>
</tr>
<tr>
<td>Anti-arrhythmics</td>
<td>15 (22)</td>
<td>8 (20)</td>
</tr>
<tr>
<td>Beta-blockers</td>
<td>15 (22)</td>
<td>8 (20)</td>
</tr>
<tr>
<td>ACE-inhibitors</td>
<td>25 (37)</td>
<td>11 (28)</td>
</tr>
<tr>
<td>Calcium-blockers</td>
<td>7 (10)</td>
<td>3 (8)</td>
</tr>
<tr>
<td>Statins</td>
<td>6 (9)</td>
<td>3 (8)</td>
</tr>
<tr>
<td>Nitrates</td>
<td>6 (9)</td>
<td>2 (5)</td>
</tr>
</tbody>
</table>

4. Discussion

The present study analysing contemporary practices shows that surgery was considered in approximately one third of asymptomatic patients with severe non-ischaemic mitral regurgitation. Decision to refer a patient to surgery or not followed the ACC/AHA recommendations in 62% of cases. Discordances with guidelines reached 38% and were mainly related to a lack of surgical referral of patients who fulfilled non-debated criteria for intervention. In non-operated patients, medical therapy was frequently used, in particular as regards vasodilators. The prevention of endocarditis was not satisfactory.

4.1. Population

Data from a tertiary centre may introduce a referral bias. In the Euro Heart Survey, inclusion sites were medical and surgical departments but also outpatient clinics where asymptomatic patients are more frequently referred or followed. Therefore, this contemporary study is likely to reflect routine real-world practice.

The data from Euro Heart Survey show that asymptomatic patients account for almost 20% of those with severe mitral regurgitation. With regard to patient characteristics and aetiology of mitral regurgitation, this series is consistent with other current studies.

We chose not to consider patients with chronic ischaemic mitral regurgitation caused by myocardial alterations despite a normal mitral valve since their management and outcome markedly differ from those with organic mitral regurgitation [10,11]. Moreover, only two patients with ischaemic mitral regurgitation claimed to be asymptomatic in this survey.

4.2. Investigations

Overall, one patient out of four had a transoesophageal echocardiographic examination. Among candidates for surgery preoperative transoesophageal echocardiography was performed in 42% of cases. Although transoesophageal echocardiography is more accurate to assess mitral lesions [12], advances in transthoracic imaging have resulted in reliable anatomical analysis and excellent prediction of repair [13].

Stress testing was seldom used in this study. Its use was not explicitly advised in guidelines at the time of the study, since its incremental role in risk stratification was not available. However, there is now growing evidence that stress testing may help to unmask symptoms and contribute to determine the optimal timing for surgery [14].

Preoperative coronary angiography was under-used, as it was missing without justification in one-third of patients. Catheterisation was probably too high since it should be restricted to difficult cases where non-invasive evaluations are inconclusive, which now occurs only in rare situations [9].

4.3. Referral to surgery

In this series, reflecting current practices, surgery was advised in 33% of asymptomatic patients with severe mitral regurgitation.

The decision to refer the patient to surgery or not was in agreement with ACC/AHA guidelines in 62% of cases. The decisions to intervene were mainly based on class I and IIa recommendations which reflects an agreement on the
benefit of intervention. Of note only eight patients (8%) were referred to surgery at a very early stage (i.e. without impairment of left ventricular function), based only on a high likelihood of repair. This indication for surgery corresponded to a class IIb recommendation in the 1998 ACC/AHA guidelines. This remains a debatable issue since it is now a class Ia recommendation in the 2006 issue of ACC/AHA guidelines and a still class IIb recommendation in the ESC guidelines [15,16].

Decision-making for surgery requires a careful assessment of the operative risk, particularly for asymptomatic patients. Hence, we considered that the presence of at least one comorbidity was a sufficient reason to decline surgery in asymptomatic patients.

A major observation of this study is that surgery was likely to be denied inappropriately in as many as 29 (29%) of patients, who met the recommendation criteria and had no comorbidity. Of these 29 patients, 20 had indices of overt left ventricular dysfunction according to ejection fraction and/or end-systolic dimension representing a class I (4 patients) or IIa (16 patients) indication for surgery. Six other patients had atrial fibrillation, which is a class IIa indication for surgery. Even in the absence of randomised trials, there is a consensus on the need for surgery when patients meet such criteria, which are associated with reduced long-term survival after mitral valve surgery for severe mitral regurgitation [17—21].

On the other hand, surgery was likely to be "over-used" in nine patients (9%). There are still controversies on how early surgery should be performed in asymptomatic patients with severe mitral regurgitation. Certain studies support early indications for surgery without waiting to reach the thresholds recommended in guidelines [4,6,7] while others support watchful waiting and advise surgery when a patient fulfills criteria corresponding to guidelines [8]. In this survey, only a small proportion of patients were operated on at a very early stage. Three of these nine patients had a left ventricular end-systolic dimension between 40 and 45 mm, which is now a class I recommendation according to the 2006 issue of ACC/AHA guidelines, although this was not the case in 2001 [9,15].

Our findings are consistent with a study based on a questionnaire sent to cardiologists, in which the prognostic value of left ventricular ejection fraction was underestimated in asymptomatic patients with severe mitral regurgitation [22].

The agreement between ACC/AHA guidelines and the decision to refer the patient to surgery or not was lower for asymptomatic mitral regurgitation (62%) than the corresponding figures for asymptomatic aortic stenosis (68%) and regurgitation (83%) in the Euro Heart Survey [23]. Unlike in patients with aortic valve diseases, discrepancies between guidelines and practices were more often related to 'under-use' rather than 'over-use' of surgery in asymptomatic mitral regurgitation [23].

4.4. Medical therapy

The use of medical therapy in an asymptomatic population in whom surgery was not planned is surprisingly high, in particular regarding the use of vasodilator therapy in patients with normal blood pressure (48%). Although there is reason to believe that pre- and after-load reduction is beneficial in mitral regurgitation, there is no data supporting a benefit according to clinical endpoints [24]. This explains why vasodilators are not advised in chronic mitral regurgitation in guidelines [9,15]. More importantly, only one third of patients aware of their valve disease had a dental examination in the preceding year, reflecting insufficient prophylaxis of infective endocarditis [25].

4.5. Implementation of guidelines

The findings of the present study highlight the need for implementing guidelines. Besides initiatives of scientific societies to disseminate guidelines, evaluation of actual practices is mandatory to point out the most important deficiencies in the application of guidelines. Although early surgery remains a source of debate, it was surprising to note that, in the present survey, the most frequent cause of discrepancy between practice and guidelines was related to the absence of surgical referral of patients for whom there is a consensus on the need for surgery.

A possible interpretation of the poor compliance with guidelines in this survey may be the relatively low underlying level of evidence of guidelines in valvular heart disease, thereby stressing the need for further trials in this field.

4.6. Study limitations

Because participating centres were not chosen to ensure epidemiological representativity, selection bias cannot be excluded. However, patients were enroled from a wide range of centres including academic and non-academic hospitals, various departments and countries, thereby limiting selection bias as compared to series from tertiary centres.

Comorbidities are not equivalent in terms of impact on operative risk and spontaneous outcome. Since there are no data on the subject in the guidelines, we chose to take any comorbidities into account as they contribute to the increase of operative risk, reduction of life expectancy and they influence the risk-benefit ratio in asymptomatic patients. In the present survey, the number of patients in whom surgery was considered under-used would have been higher if comorbidities were not taken into account.

We did not analyse local resources on the expertise in mitral valve repair. However, the absence of feasibility of valve repair may be involved in only 5 of the 29 patients who were not referred to surgery despite fulfilling class I or II recommendation. In the 24 other cases, intervention should have been performed according to guidelines, whatever it was valve repair or prosthetic valve replacement.

This study was not designed to determine whether the decision to refer the patient to surgery or not was justified in each individual patient. Indeed, the decision-making process includes non-measurable subjective components. Nevertheless, this study provides a unique comparison of real practice and published recommendations.

5. Conclusion

In conclusion, in this survey reflecting current clinical practice, investigations were characterised by a probable
under-use of stress testing and coronary angiography, while cardiac catheterisation seemed over-used. A third of asymptomatic patients with severe mitral regurgitation were considered candidates for surgery. Concerning the therapeutically effective, this study points out that a large number of patients were not referred to surgery even though they fulfilled recommendations for intervention, in particular to avoid late left ventricular dysfunction. The current debate on the possible benefit of early intervention should not lead to the overlooking of patients who have non-debatable criteria. Besides the need to improve the level of evidence supporting future guidelines, the findings of this survey underline the need to improve the implementation of existing guidelines to avoid too late surgical referral.

References