Mitral regurgitation: Determinants of referral for cardiac surgery by Canadian cardiologists

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PURPOSE: Advances in surgery permit for earlier intervention with improved outcomes for patients with mitral regurgitation (MR). Many patients still appear to be referred to surgery late in their course. Consensus guidelines were compared with the surgical referral practices for MR among Canadian cardiologists.

METHODS: A self-administered questionnaire was mailed to all adult cardiologists in Canada. This included seven case scenarios, as well as direct questions designed to establish the influence of factors including atrial fibrillation, pulmonary hypertension, left ventricular (LV) dilation, experience of the cardiac surgeon, symptoms and ejection fraction (EF) on referral.

RESULTS: There were 319 respondents; LVEF was rated as extremely important in 71.5% of patients and moderately important in 26% of patients. In asymptomatic patients, EF of 50% to 60% was correctly identified as a trigger for surgery by 57.2 % of cardiologists, while only 15.6% of cardiologists correctly referred New York Heart Association class II patients with normal LV function. The group complied in only 4.77 of the seven case scenarios. Compliance was inversely related to years in practice for asymptomatic patients with mild LV dysfunction, as well as in overall compliance. Referral practices were similar among clinicians, echocardiographers, interventional cardiologists and researchers, with no differences in geographic region or academic affiliation.

CONCLUSION: Compliance with published guidelines for patients with MR and either New York Heart Association class II or mild LV dysfunction among Canadian cardiologists was poor. Compliance was somewhat better in more recent graduates, suggesting the need to institute programs geared at enhancing knowledge of published standards and introduce practical tools to aid in their implementation.

Key Words: Echocardiography; Mitral valve; Regurgitation; Surgery

The optimal timing for surgery in mitral regurgitation (MR) has been an issue of debate over the past several decades. The medical community has moved from an era in which medical therapy was the only available option for MR to one in which surgical advances have superceded medical management. Despite studies supporting an early surgical approach to MR, many cardiovascular surgeons believe that patients are still referred late in the course of the disease.

The spectrum of mitral valve disease has changed significantly over the past 30 years, with a decline in rheumatic disease, and an increase in myxomatous degeneration and ischemic MR (1,2). As a result, more than two-thirds of

La régurgitation mitrale : Les déterminants d'aiguillage en chirurgie cardiaque par les cardiologues canadiens

OBJECTIF : Les avancées en chirurgie permettent d'intervenir plus rapidement et d'obtenir de meilleurs résultats auprès des patients atteints de régurgitation mitrale (RM). De nombreux patients semblent encore être aiguillés en chirurgie tardivement dans l'évolution de leur maladie. On a comparé les lignes directrices consensuelles aux pratiques d'aiguillage en chirurgie chez les cardiologues canadiens.

MÉTHODOLOGIE : On a posté un questionnaire autoadministré à tous les cardiologues pour adultes au Canada. Ce questionnaire comprenait sept scénarios de cas, ainsi que des questions directes conçues pour établir l'influence de facteurs, comme la fibrillation auriculaire, l'hypertension pulmonaire, la dilatation ventriculaire gauche (VG), l'expérience du chirurgien cardiaque, les symptômes et la fraction d'éjection (FÉ), sur l'aiguillage.

RÉSULTATS : Il y a eu 319 répondants. La FÉVG était classée comme d'une importance extrême chez 71,5 % des patients et d'une importance modérée chez 26 % d'entre eux. Chez les patients asymptomatiques, 57,2 % des cardiologues indiquaient correctement qu'une FÉ de 50 % à 60 % était un indicateur de chirurgie, tandis que seulement 15,5 % des cardiologues aiguillaient correctement les patients de stade II selon la classification de la *New York Heart Association* dont la fonction VG était normale. Le groupe ne respectait que 4,77 des scénarios de cas. Ce respect était inversement proportionnel aux années de pratique chez les patients asymptomatiques au dysfonctionnement VG bénin, ainsi qu'au respect global. Les pratiques d'aiguillage étaient similaires chez les cliniciens, les échocardiographes, les cardiologues d'intervention et les chercheurs, et on ne remarquait aucune différence selon la région géographique ou l'affiliation universitaire.

CONCLUSION : Les cardiologues respectaient peu les lignes directrices publiées au sujet des patients de stade II selon la classification de la *New York Heart Association* et atteints de RM ou présentant un dysfonctionnement VG bénin. Les plus jeunes diplômés respectaient un peu mieux ces lignes directrices, ce qui indique la nécessité d'implanter des programmes pour améliorer les connaissances des normes publiées et d'adopter des outils pratiques pour contribuer à cette implantation.

patients are thought to be candidates for valve repair. Isolated MR is associated with elevated morbidity and mortality (3). The overall survival in chronic MR appears to improve with surgical therapy in patients with either normal or reduced left ventricular (LV) function (4).

The strongest and most consistent predictor of outcome, in terms of postoperative ejection fraction (EF) and survival after surgery, is preoperative EF (1,5-7). In fact, the best surgical outcome is observed in patients with EF of 60% or greater, with a low incidence of postoperative congestive heart failure and survival at 10 years, which is similar to that of an age-matched population (8). In addition, with the development of mitral

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TABLE 1
Case scenario and surgical referral

Case	Case description	Referring cardiologists, %	ACC/AHA recommendation
1	Asymptomatic, moderate MR, EF of 70%	1	No surgery, follow-up
2	Asymptomatic, moderate to severe MR, EF of 60%, repairable valve	6.4	Surgery, class IIa
3	Newly symptomatic, EF of 55%, valve not repairable	83.5	Surgery, class I
4	Symptomatic ischemic moderate to severe MR, EF of 60%, double-vessel disease	89.2	Surgery, class I
5	Asymptomatic, moderate to severe MR, EF of 60%, valve not repairable	9.6	Surgery, class IIa
6	Symptomatic NYHA class IV, EF of 30%, myxomatous valve	81.2	Surgery, class I
7	New-onset atrial fibrillation, moderate to severe MR, EF of 60%	35.2	Surgery, class IIa

Percentage of cardiologists referring patients for surgery for each scenario described, as well as the American College of Cardiology/American Heart Association (ACC/AHA) recommendation for the given scenario. EF Ejection fraction; MR Mitral regurgitation; NYHA New York Heart Association

valve repair and its lower associated operative mortality (9-11), the threshold for intervention in patients with MR should be lowered when repair is feasible. As a result, there has been a significant trend in the literature for surgical correction at an earlier stage, ideally when EF 60% or greater and before the end-systolic diameter exceeds 45 mm, to preserve ventricular function (1,8,12-14).

As a result of the above findings, the American College of Cardiology (ACC), the American Heart Association (AHA), and more recently, the Canadian Cardiovascular Society, have published guidelines for the management of valvular heart disease, including indications for surgical intervention in patients with MR (15,16). Despite these guidelines, it was thought by many cardiovascular surgeons that patients were being referred late for surgery. The purpose of the present study was to evaluate whether Canadian cardiologists were following the ACC/AHA consensus criteria for surgical referral in mitral valve regurgitation, and to identify the instances in which these criteria were not being followed.

METHODS

All adult cardiologists and cardiac surgeons registered with the Royal College of Physicians and Surgeons of Canada were identified and were sent self-administered questionnaires. The questionnaire included seven case scenarios (Table 1) and direct questions designed to establish the influence of such factors as valve repairability based on echocardiographic appearance, new-onset atrial fibrillation (AF), concomitant ischemic heart disease, clinical symptoms such as dyspnea on exertion, and EF on surgical referral. The case scenarios assessed general adherence to ACC/AHA surgical guidelines for MR while emphasizing different surgical referral criteria.

A scoring system was devised to create an index of compliance with AHA/ACC guidelines, whereby the response to each case scenario was evaluated with respect to the recommendations of the ACC/AHA guidelines. This index of compliance also included the proportion of cardiologists who correctly identified the minimum decrease in LV function that would trigger surgical referral in asymptomatic and New York Heart Association (NYHA) class II patients with MR.

A total of two mailings were sent to increase the response rate. Confidentiality of the responding cardiologists was ensured.

Descriptive statistics, including frequency distributions for categorical variables and measures of central tendency and dispersion for continuous variables, were produced. The significance of factors associated with referral for surgery was evaluated for statistical significance with χ^2 analysis. All associations with an alpha level below 5% were considered to be statistically significant.

RESULTS

Physician characteristics

Of the 776 eligible cardiologists, 319 (41%) responded to the questionnaire. The geographic distribution of the respondents differed significantly; however, it was proportional to the distribution of cardiologists in Canada. The majority of respondents resided in Ontario (36.2%) and Quebec (35.6%); 21% resided in the western provinces and 7% in the eastern provinces.

The largest group of respondents were between 36 and 45 years of age (41.4%), while only 4.1% of respondents were above the age of 65 years. Most respondents were male (87.8%), and graduated from medical school between 1970 and 1989 (72.7%). The mean ($\pm$ SD) duration of practice was 14.4 ± 9.6 years.

Most respondents were affiliated with university hospitals (66.1%), and the remainder were from community hospitals (33.8%). The majority of respondents incorporated clinical cardiology in their practice (92.8%). Of the respondents, 37.6% were involved in research, 31% were interventional cardiologists and 55.5% were trained in echocardiography.

Factors influencing referral for surgery

EF: When asked about the importance of EF in determining the timing of surgery, 71.5% of cardiologists responded that it was of extreme importance, while 26% responded that it was of moderate importance. The minimum decrease in LV function to trigger surgical referral in patients with MR was assessed in asymptomatic and symptomatic NYHA class II patients. 57.2% of cardiologists would correctly refer asymptomatic patients for mitral valve repair or replacement based on an EF of 50% to 60%, 31.6% would wait for an EF of 49% or lower and 7.4% of cardiologists would refer patients with moderate to severe MR based on symptoms, regardless of EF (Table 2). There was no significant difference in the referral of asymptomatic patients on the basis of hospital versus community practice or field of expertise in cardiology (Tables 2 and 3). There were significant differences in referral patterns on the basis of the physician's year of graduation, with more recently graduated physicians being more consistent with ACC/AHA guidelines in referring asymptomatic patients when the EF was in the 50% to 60% range ($P=0.005$) (Table 4).

The minimum decrease in LV systolic function that would trigger surgical referral in NYHA class II patients was also assessed. Only 15.6% of cardiologists would correctly refer patients with NYHA class II and moderately severe MR to surgery if their LV function was normal (EF greater than 60%). 55.2% of cardiologists would wait until the EF dropped to 50%

TABLE 2
University or community cardiology practice and surgical referral in patients with moderate to severe mitral regurgitation

Referral criteria evaluated	Overall, n (%)	Community, n (%)	University, n (%)	ACC/AHA guidelines
Asymptomatic (referral threshold)				
EF > 60%	2 (0.9)	1 (1.6)	1 (0.8)	No surgery
EF 50%–60%	123 (57.2)	37 (57.8)	64 (55.2)	Surgery, class I
EF 40%–49%	68 (31.6)	20 (31.2)	40 (34.5)	Surgery, class I
EF < 40%	6 (2.8)	3 (4.7)	3 (2.6)	Surgery, class I
Symptoms regardless of EF	16 (7.4)	3 (4.7)	8 (6.9)	Surgery, class I
NYHA II (referral threshold)				
EF > 60%	32 (15.5)	12 (20.0)	15 (13.6)	Surgery, class I
EF 50%–60%	11.5 (55.8)	33 (55.0)	64 (58.2)	Surgery, class I
EF 40%–49%	43 (20.9)	11 (18.3)	25 (22.7)	Surgery, class I
EF < 40%	3 (1.5)	1 (1.7)	1 (0.9)	Surgery, class I
Further symptoms	13 (6.3)	3 (5.0)	5 (4.5)	Surgery, class I
New-onset AF	94 (32.9)	24 (30.8)	54 (34.4)	Surgery, class IIa

In this survey, cardiologists identified the minimum decrease in left ventricular function that would trigger surgical referral for mitral valve surgery in both asymptomatic patients and symptomatic patients with New York Heart Association (NYHA) class II. The percentage of cardiologists who would refer asymptomatic patients with mild left ventricular dysfunction (ejection fraction [EF] of 60%), and new-onset atrial fibrillation (AF) was also surveyed. ACC/AHA American College of Cardiology/American Heart Association

to 60%, while 20.8% would refer when the EF decreased further to 40% to 49%. Of the cardiologists surveyed, 63% would wait until the patient became more symptomatic to NYHA class III or IV (Tables 2 to 4). There was no difference in referral pattern based on year of graduation or practice profile.

AF: New-onset AF with a dilated left atrium influenced 32.9% ($P=0.004$) of respondents to refer to surgery patients with moderate to severe MR and EF of 60%. There was no statistically significant difference in referral pattern based on community versus academic practice, research, angiography or echocardiography. Cardiologists who graduated earlier were more likely to refer patients with MR for surgery (34.5%) compared with cardiologists who graduated more recently (30.8%) ($P=0.032$) (Table 4).

Left atrial size was of little or no importance according to 44% of respondents. However, the presence of concomitant coronary artery disease (CAD), the degree of MR, pulmonary artery pressure and end-systolic diameter were of extreme or moderate importance in determining the timing for surgery according to 82.9% to 94% of cardiologists surveyed. The most important factor was the experience of the cardiac surgeon in valve repair at the given centre, and this was of extreme or moderate importance according to 97% of responding cardiologists (Table 5).

Case scenarios

The surgical referral pattern was similar among clinical cardiologists, echocardiographers, researchers and interventional cardiologists (Tables 2 and 3). In asymptomatic patients with preserved LV function, 99% of cardiologists did not refer for surgery (ACC/AHA guidelines class IIb). However, cardiologists referred patients with MR to surgery late when they were asymptomatic with mild LV dysfunction (cases 2 and 5, Table 1), even if the valve was considered amenable to repair (case 2, Table 1).

TABLE 3
Cardiology practice profile and surgical referral in patients with moderate to severe mitral regurgitation

Referral criteria evaluated	Research, n (%)	Clinical, n (%)	Echo, n (%)	Cath, n (%)
Asymptomatic (referral threshold)				
EF > 60%	1 (1.1)	2 (1.0)	0 (0)	1 (1.4)
EF 50%–60%	58 (63)	112 (56.3)	81 (63.3)	41 (56.9)
EF 40%–49%	28 (30.4)	65 (32.7)	36 (28.1)	23 (31.9)
EF < 40%	1 (1.1)	6 (3.0)	2 (1.6)	3 (4.2)
Symptoms regardless of EF	4 (4.3)	14 (17)	9 (7)	4 (5.6)
NYHA II (referral threshold)				
EF > 60%	17 (19.5)	30 (15.6)	23 (18.8)	13 (18.3)
EF 50%–60%	47 (54)	106 (55.2)	66 (54.1)	36 (50.7)
EF 40%–49%	18 (20.7)	40 (20.8)	23 (18.8)	17 (23.9)
EF < 40%	0 (0)	3 (1.6)	2 (1.6)	2 (2.8)
Further symptoms	5 (5.7)	13 (6.8)	8 (6.6)	3 (4.2)
New-onset AF	37 (35.2)	87 (32.9)	51 (31.9)	30 (33.0)

In this survey, cardiologists identified the minimum decrease in left ventricular function that would trigger surgical referral for mitral valve surgery in both asymptomatic patients and symptomatic patients with New York Heart Association (NYHA) class II. The percentage of cardiologists who would refer asymptomatic patients with mild left ventricular dysfunction (ejection fraction [EF] of 60%) and new-onset atrial fibrillation (AF) was also surveyed. Echo Cardiologists trained in echocardiography; Cath Interventional cardiologists

TABLE 4
Year of graduation and surgical referral in patients with moderate to severe mitral regurgitation

Referral criteria evaluated	1969 and earlier, n (%)	1970–1979, n (%)	1980–1989, n (%)
Asymptomatic (referral threshold)			
EF > 60%	0	1 (1.3)	1 (1.1)
EF 50%–60%*	13 (39.4)	36 (47.4)	61 (70.1)
EF 40%–49%	12 (36.4)	32 (42.1)	19 (21.8)
EF < 40%	1 (3)	4 (5.3)	0
Symptoms regardless of EF	7 (21.2)	3 (3.9)	6 (6.9)
NYHA II (referral threshold)			
EF > 60%	4 (12.1)	10 (13.7)	14 (17.3)
EF 50%–60%	16 (48.5)	37 (50.7)	52 (64.2)
EF 40%–49%	9 (27.3)	18 (24.7)	12 (14.8)
EF < 40%	0	3 (4.1)	0
Further symptoms	4 (12.1)	5 (6.8)	3 (3.7)
New-onset AF**	19 (34.5)	32 (33.0)	33 (30.8)

* $P=0.0005$; ** $P=0.032$. In this survey, cardiologists identified the minimum decrease in left ventricular function that would trigger surgical referral for mitral valve surgery in both asymptomatic patients and symptomatic patients with New York Heart Association (NYHA) class II. The percentage of cardiologists who would refer asymptomatic patients with mild left ventricular dysfunction and new-onset atrial fibrillation (AF) was also surveyed. EF Ejection fraction

Cardiologists were more consistent with practice guidelines in referring symptomatic patients with mild (83.5% of cardiologists) or severe (81.2% of cardiologists) LV dysfunction (cases 3 and 6, Table 1). The presence of concomitant CAD in symptomatic patients with mild LV dysfunction had the highest referral pattern, with 89.2% of cardiologists correctly referring these patients for surgery (case 4, Table 1). Symptomatic patients with mild LV dysfunction (EF of 60%) and new-onset AF were also referred late for surgery (case 7, Table 1).

TABLE 5
Parameters in the determination of timing of surgery

	Left atrial size n (%)	Degree of MR n (%)	LVESD n (%)	PA pressure n (%)	Surgeon experience, n (%)
No importance	19 (6.1)	4 (1.3)	0	3 (1)	3 (1)
Little importance	118 (37.8)	18 (5.8)	19 (6.3)	32 (10.3)	14 (4.5)
Moderate importance	150 (48.1)	166 (53)	120 (30)	178 (57.2)	93 (30.8)
Extreme importance	25 (8)	124 (39.7)	163 (54)	98 (31.5)	200 (66.2)

LVESD Left ventricular end-systolic diameter; MR Mitral regurgitation; PA Pulmonary artery

The adherence to ACC/AHA guidelines was evaluated on the basis of the seven clinical scenarios in Table 1 and the minimum decrease in LV function that would trigger surgical referral in asymptomatic and NYHA II patients. The mean score was 4.77 of seven (Table 6). There was a slightly lower level of compliance with ACC/AHA guidelines among cardiologists who graduated earlier ($P<0.05$).

DISCUSSION

Our study supports the hypothesis that patients with MR are being referred later than recommended by the ACC/AHA guidelines for surgical management of mitral valve disease. There was surprising under-referral for asymptomatic and symptomatic patients with EF between 50% to 60%, despite consistent literature illustrating the survival benefits of surgical referral for valve repair before the onset of irreversible LV dysfunction. In their study, Enriquez-Sarano et al (5) clearly demonstrated that 10-year survival in patients with isolated MR who were undergoing valve repair was dependent on preoperative EF. Survival in patients undergoing valve repair with preoperative EF of 60% or greater did not differ from that of the age-matched population. In addition, they showed a similar stepwise decline in survival curves in relation to EF in patients undergoing mitral valve replacement. These data are not surprising, in view of our current understanding of the natural history of MR; the onset of contractile dysfunction typically occurs while patients are asymptomatic, and ejection phase indexes of LV performance remain within the normal range (17,18) as a result of the favourable preoperative loading conditions (19-21). By the time patients become overtly symptomatic with exhaustion, decreased exercise tolerance and congestive heart failure, severe irreversible contractile dysfunction may have already developed (22,23). Thus, surgery is recommended for MR, even when symptoms are absent or mild (NYHA class I or II) and LV function is near the lower limit of normal (LV function 55% to 60% or fractional shortening 30% to 32%) (24,25). The ACC/AHA guidelines for MR support surgery for symptomatic or asymptomatic patients with mild LV dysfunction, defined as EF of 50% to 60% and end-systolic dimension of 45 mm to 50 mm. They also recommend mitral valve surgery in patients experiencing dyspnea (NYHA functional class II, III or IV) even if they have normal ventricular function, defined as EF of greater than 60% and end-systolic dimension of less than 45 mm (15).

Despite the evidence for earlier surgical referral in MR, our study suggests that cardiologists delay referral in asymptomatic patients with mild LV dysfunction. Only 57% of cardiologists surveyed correctly identified an EF of 50% to 60% in asymptomatic patients as the minimum decrease in LV function that

TABLE 6
**Overall adherence to American College of Cardiology/
American Heart Association guidelines**

	Mean score (of 7), %
Overall	4.77
Year graduated medical school*	
1969 and earlier	4.2
1970-1979	4.4
1980-1989	4.8
1990 and later	4.8
Angiography	
Yes	4.8
No	4.7
Echocardiography	
Yes	4.8
No	4.6
Research	
Yes	4.9
No	4.6
Practice type	
Community	4.8
University	4.8
Clinical cardiology	
Yes	4.8
No	4.7

* $P<0.05$

should trigger surgical referral in patients with MR. Among these patients, cardiologists who graduated more recently answered more consistently in accordance with ACC/AHA guidelines, but the surgical referral pattern was similar among clinical cardiologists, echocardiographers, researchers and angiographers (Tables 2 to 4). An increase in LV size was considered to be of moderate or extreme importance by 84% of cardiologists in determining the timing of surgery, while mild LV dysfunction was not recognized as an important indicator of referral. LV dilation may be considered by the cardiologists surveyed as a more ominous sign of LV dysfunction than an EF of 60%. The low surgical referral in patients with significant MR and EF of 60% may also represent a failure to appreciate that EF of 60% in this setting represents mild LV dysfunction.

Cardiologists were more consistent with practice guidelines in referring symptomatic patients with mild or severe LV dysfunction (cases 3 and 6). The presence of concomitant CAD in symptomatic patients with mild LV dysfunction had the highest referral pattern with 89.2% of cardiologists correctly referring these patients for surgery (case 4).

In the ACC/AHA guidelines for the management of patients with valvular heart disease, the feasibility of repair is an important criterion in the decision to refer patients for surgery. In the case scenarios, there was poor referral of asymptomatic patients with mild LV dysfunction and a nonrepairable valve (case 5), although this is considered a class IIa indication. The referral was not increased when this case scenario was modified to include a repairable valve (case 2). Although the presence of a repairable valve in these two case scenarios did not seem to impact referral, most cardiologists mentioned that experience of the cardiac surgeon in valve repair was of moderate or extreme importance.

In asymptomatic patients with mild LV dysfunction (EF of 60%) and new-onset AF, the surgical referral was only 35.2% (class IIa indication). There was also significant under-referral

for valve repair in patients with new-onset AF. Studies have shown that preoperative duration of AF of less than three months is prognostic for conversion to sinus rhythm postoperatively (26), with a dramatic decrease in the conversion rate once the AF is present for over a year (27). According to these studies, the development of AF may be considered a turning point in the course of MR and may serve as an impetus for surgical referral even in asymptomatic patients with a preserved LV function (class IIa indication).

Late surgical referral may also be due to the difficulty in referring patients who have few, if any, symptoms to surgery, which certainly carries its risks. Cardiologists may also not yet be confident of the success of valve repair in their particular institution, and may also be biased by the morbidity and mortality rates before the surgical techniques were perfected. In fact, 97% of cardiologists indicated that the experience of the cardiac surgeon in valve repairs was of extreme or moderate importance in their decision to refer the patient to cardiac surgery.

Guidelines applied in practice

There has been a recent interest in literature on adherence to guidelines. Studies have looked at adherence to guidelines in hypertension management (28), diabetes (29), community-acquired pneumonias (30) and acute coronary syndromes (31), among others. These studies consistently show a lack of adherence to guidelines (in the 55% to 85% range), with consequent increase in morbidity and mortality for patients in whom the guidelines were not followed.

Although practice guidelines have been shown to influence practice patterns, the degree of improvement varies considerably (32). The dissemination of information within the guidelines has proven to be an important determinant of their adherence. There has been evidence for the use of 'opinion leaders' – trusted individuals or department heads in institutions to propagate evidence-based guidelines to their colleagues. In addition, the use of critical pathways has been established to improve adherence to guidelines and may have led to better outcomes for cardiac surgery (33), chest pain (34) and thrombolysis (35).

The lack of adherence to evidence-based guidelines in myocardial infarctions (31), including the underuse of acetylsalicylic acid, heparin, beta-blockers and reperfusion therapy, has led to several initiatives to improve the application of evidence-based medicine in this setting. The Guidelines Applied in Practice Initiative (36) is a quality-of-care project devised to implement evidence-based guidelines for acute coronary syndromes using tools such as critical pathways, assignment of local physician and nurse opinion leaders, grand rounds site visits, standard orders, pocket cards, chart stickers and patient handouts (36). This intervention resulted in a significant increase in adherence to key treatments in the acute myocardial infarct setting. Similar initiatives may be necessary to improve adherence to guidelines in the management of valvular heart disease.

Duration of practice since graduation

Cardiologists who completed their training more recently were likely to be more consistent with current guidelines. In the present survey, 70% of the more recent graduates referred patients for surgery with mildly reduced LV systolic function, compared with only 39% of those who completed their training earlier. Similarly, they had a significantly higher compliance scores in the seven case scenarios, scoring 4.8 versus 4.2 of seven cases. This is consistent with previous findings

investigating the relationship between clinical experience and quality of health care. Norcini et al (37) reported a 0.5% increase in mortality per year since medical school graduation in a group of 4546 cardiologists, internists and family physicians caring for acute myocardial infarction patients. In a comprehensive review of all such studies, Choudhry et al (38) found that 70% demonstrated a consistently or partially negative association between time in practice or physician age and adherence to standards of care. This negative association was similar in either self-reported studies or those using objective measures. There are many explanations for this, including older physicians being less likely to adopt newly proven strategies into their practices or being less familiar with newer technologies. In addition, older physicians may rely more on humanistic rather than technical aspects of medicine, and may draw on experience in similar cases. Finally, while recognizing that guidelines of practice are usually written based on expert consensus, they often have varying levels of strength of evidence, and older physicians may draw on their experience in similar cases. Unlike the management of acute myocardial infarction or unstable angina, in the case of surgical management of MR, the level of evidence is much weaker. There are no randomized trials, and most data come from retrospective observational studies, often from ultraspecialized single centres. In the setting of ischemic MR, studies have demonstrated that its mere presence markedly increases long-term mortality, but we lack studies proving that its repair will result in an improved outcome. Despite this, current Canadian guidelines suggest mitral repair or replacement for 2+ or 3+ MR, or greater. Cardiologists who completed their training more recently had studied these guidelines, particularly for the purpose of passing examinations, but may not appreciate the above limitations of such guidelines when faced with an individual patient.

Limitations

The present study has some limitations. The sample of cardiologists who agreed to participate in the study may differ in their attitudes and beliefs from the general population of cardiologists practising in Canada. However, it is likely that the cardiologists who participated in the survey have a greater interest in the management of valvular heart disease. As such, our findings may represent a more positive scenario than in the broader cardiology practice. The present study was performed on Canadian cardiologists before the publication of Canadian guidelines for surgical management of valvular heart disease. However, this is unlikely to be a significant factor in the lack of adherence to the guidelines because the American guidelines are widely accepted in Canada. Finally, the present study used surveys with clinical scenarios from which we attempted to deduce clinical practice. Although it is possible that the responses to the scenarios differed from clinical practice, we would have expected that this may lead to a bias in favour of the guidelines.

CONCLUSION

The present survey of Canadian cardiologists suggests that there is an overall 66% compliance with ACC/AHA guidelines for surgical referral in patients with MR, but our data suggest that there is variation in practice among Canadian cardiologists. Cardiologists who trained more recently tended to adhere more closely to the ACC/AHA guidelines. There is late surgical referral compared with ACC/AHA guidelines in asymptomatic patients with new-onset AF and mildly

depressed LV function (EF 50% to 60%), even if the valve is considered repairable. There is also late referral in symptomatic patients with NYHA class II and preserved LV function (EF greater than 60%). However, surgical referral is consistent with ACC/AHA guidelines in symptomatic patients with either mild or severe LV dysfunction. It is crucial to identify and refer patients with MR who are amenable to valve repair early – assuming a low risk of the procedure in the given centre – to avoid the need for prosthetic devices, decreased post-operative EF and excess perioperative and long-term mortality.

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