Timing of Valve Replacement for Aortic Stenosis

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Valve replacement for aortic stenosis is easily recognized as life saving, because of the short survival of most patients with advanced symptomatic stages of aortic stenosis. However, there is an increased late mortality from congestive heart failure occurring years after the aortic valve replacement. This problem has been thought to relate to irreversible myocardial changes, manifested morphologically as myocardial hypertrophy and interstitial fibrosis.1 Valve replacement earlier in the natural history of aortic stenosis has been advocated but has been restrained by the risk of complications of the artificial valve.

The Lund Series

In this issue of Circulation,2 Dr. Ole Lund of the Aarhus University Hospital in Denmark presents an analysis of 630 patients who have been observed for up to 22 years after aortic valve replacement for aortic stenosis. Mechanical prostheses were used almost exclusively, including the Starr-Edwards silastic ball (33%), the Starr-Edwards cloth-covered model (21%), the Starr-Edwards track valve (23%), the St. Jude valve (15%), and several other mechanical models (6%). Only 15 patients (2.4%) had bioprostheses.

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Late mortality occurred at rates of 3–4% per year. Seventy-eight percent of the late deaths were caused by heart disease, including chronic congestive heart failure (30%), prosthetic valve-related complications (18%), myocardial infarction (16%), and arrhythmia (8%). Multivariate statistical analysis identified eight variables that had statistically significant independent correlation with late mortality. The variables included age, male gender, peak systolic pressure gradient (inversely correlated), cardiac enlargement in the plain chest roentgenogram, pulmonary vascular congestion by physical examination or chest roentgenogram, ventricular premature beats more frequent than 10% of the beats in a resting electrocardiogram, the use of antianginal or antiarrhythmic medications, and the use of a prosthetic valve with an orifice diameter smaller than 15 mm. The eight variables were combined into a risk score that allowed the patients to be stratified into eight risk categories. The incidence of late mortality was strongly related to the risk score. Indeed, the approximately one half of the patients who had the most favorable preoperative risk profiles had a long-term survival rate that was not demonstrably different from that of the general Danish population of the same age. A policy of earlier valve replacement for aortic stenosis is therefore advocated. Several points relating to such a conclusion need to be considered.

Do These Results Apply to the Elderly?

The Lund series includes patients as old as 78 years, with a mean age of 59 years. This is a younger age distribution than would be typical of a contemporary series, especially in the United States. Aortic stenosis is a disease of the elderly. Improved surgical results have led to the use of aortic valve replacement in more elderly patients than was usual in the 1960s and 1970s (including many in their 80s).3 Elderly patients have differences in clinical presentation and have higher operative and late mortality risks than do younger patients. These differences need to be considered with regard to the issue of earlier valve replacement.

Can Congestive Heart Failure Be Anticipated?

Overt congestive heart failure certainly represents a later stage than is desirable for performing valve replacement in patients with aortic stenosis, as does a reduced left ventricular ejection fraction and an elevated end-systolic volume.4 Although only 11% of the patients in the Lund series were in the New York Heart Association functional class IV, 36% had clinical evidence of pulmonary vascular congestion, and 61% were taking digitalis or diuretics before the operation. There was apparently a reluctance to recommend operation at a stage in which relatively mild exertional dyspnea was the only symptom. This is understandable, particularly in a past era when cardiac catheterization was required to prove the presence of critical aortic stenosis. Mild exertional dyspnea may be difficult to distinguish from normal...

The opinions expressed in this editorial comment are not necessarily those of the editors or of the American Heart Association.

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physical capacity, especially in elderly people. A
discriminating interpretation of the history and phys-
ical signs and the ready availability of Doppler ultra-
sound studies to determine the transvalvular aortic
pressure gradient are the keys to recognizing severe
aortic stenosis at an early symptomatic stage.

Can Noninvasive Studies Identify Early Left
Ventricular Dysfunction?
The ability of noninvasive studies to identify early
left ventricular dysfunction has been extensively
examined in the case of aortic regurgitation, where
measurements such as left ventricular cavity diam-
ter in systole and diastole and the ejection fraction
have been used. Whether measurements such as left
ventricular wall thickness or peak diastolic filling rate
could be used in a similar manner in patients with
aortic stenosis remains to be seen. Another difficulty
is that the measurements relevant to early left ven-
tricular dysfunction in aortic stenosis could also
reflect hypertension and coronary artery disease.

In thinking about the early signs of left ventricular
dysfunction, there may be an assumption that aortic
stenosis typically develops to a severe degree, and then
the left ventricular dysfunction develops secondarily,
with symptoms following in a still later stage. How-
ever, it may be that these three processes are more
parallel than sequential, especially in the elderly.
Patients in the older age groups who have retained
normal left ventricular function will frequently not yet
have a critical degree of aortic stenosis.

What Is the Role of Coronary Artery Disease?
Coronary artery disease is frequently present in
patients with aortic stenosis who are older than 40
years, even in the absence of angina pectoris. It is
likely that the predictive value of such factors as age,
male gender, and frequent ventricular premature
beats in the Lund series reflect the role of coronary
disease, at least in part. Coronary arteriography was
performed in only 31% of Lund's patients, generally
in those who were seen after 1975 and who had
angina as a limiting symptom. Performing coronary
artery bypass at the time of the aortic valve replace-
ment is effective in relieving angina but has not yet
been shown to improve the long-term survival. Thus,
the frequent coexistence of coronary artery disease
and aortic stenosis limits the improvement in long-
term survival that could theoretically be obtained by
performing earlier aortic valve replacement.

Should Truly Asymptomatic Patients Have Aortic
Valve Replacement?
Mild exertional dyspnea as the only symptom is
more difficult to recognize than angina, syncope, or
congestive heart failure, and it merges imperceptibly
into the truly asymptomatic state. Some clinical stud-
ies have grouped together the asymptomatic and
mildly symptomatic patients because of this
difficulty. A policy of early operation would probably
require operating on many truly asymptomatic
patients as well as those with exertional dyspnea as
the only symptom. Children and young adults are
often truly asymptomatic with severe aortic stenosis,
probably because they are more likely to retain
normal left ventricular function into a late stage of
the disorder. Operation is indicated in such cases
primarily because of the risk of sudden death and
also because the procedure can often be a commis-
sueryotomy or balloon valvuloplasty rather than valve
replacement. Older adults are rarely truly asympto-
matic in the presence of the most severe grades of
aortic stenosis. Furthermore, sudden cardiac death in
older patients with asymptomatic aortic stenosis
appears to be rare. Therefore, the benefits of pro-
phylactic aortic valve replacement compared with the
operative risk and the risk of later prosthetic valve-
related complications needs to be balanced with
particular care in older patients.

How Important Are Late Prosthetic
Valve-Related Complications?
If the artificial heart valves were as free of compli-
cations as a normal human valve, there would be
little doubt that the proper time for aortic valve
replacement would be in the asymptomatic stage, as
soon as it became clear that the nature of the valvular
disease is such that eventual symptoms and prema-
ture death would assuredly occur. The situation
would be similar to that of essentially curable condi-
tions such as patent ductus arteriosus. Unfortunately,
the search for such an ideal valve substitute is still
unfulfilled. In the Lund series, prosthetic valve-
related complications, such as thromboembolism,
anticoagulant-related hemorrhage, infective
endocarditis, hemolytic anemia, paravalvular leaks,
and structural valve failure, occurred at the rate of
approximately 5% per year. These complications
were fatal in about 15% of instances and accounted
for 18% of the late deaths. These figures are similar
to those of other recent studies, for both mechanical
and bioprosthetic devices.

Are the Prosthetic Valve-Related Complications
Patient Related?
The Lund study, as well as several others in recent
years, suggests that prosthetic valve-related complica-
tions are correlated with unfavorable preoperative
risk factors and may therefore be patient related
rather than strictly valve related. There is an
implication that valve replacement performed earlier
in the natural history would result in a lower inci-
dence of late prosthetic valve-related complications.
The evidence is not clear on this point, however. The
issue relates partly to the definition of a complication
as valve related. Definitions that are most appro-
priate for comparing one prosthetic device with
another may not be the most appropriate for other
comparative purposes. A definition that includes all
cerebral ischemic episodes that are otherwise unex-
plained is probably accurate in young patients, but in
the elderly, this definition undoubtedly leads to the
inclusion of some episodes that are not directly valve related. Likewise, anticoagulant-related hemorrhage is only indirectly valve related and will also be more frequent in older patients who have a variety of unfavorable preoperative risk factors. It appears that paravalvular leaks, infective endocarditis, hemolytic anemia, or structural failure of mechanical prostheses are not significantly patient related. Thus, it appears doubtful whether the higher incidence of thromboembolism and anticoagulant-related hemorrhage in elderly patients after aortic valve replacement, compared with younger patients, should be used as a reason for performing the operation at an earlier age. These complications may rather be taken as a reason for preferring a bioprosthesis for aortic valve replacement in the elderly;17 in this age group, the bioprosthesis has significantly less structural failure than in younger patients. The advantage of the bioprosthesis in the elderly is probably even greater in the United States because of the diversity of the population and the medical care system. The more cohesive nature of the population and the medical care system in Denmark probably provides a nearly optimal setting for the use of anticoagulation to prevent thromboembolic complications of prosthetic heart valves.

Summary

The Lund study provides useful new data on the relation between preoperative clinical features and the long-term course after valve replacement for aortic stenosis. The advantage of performing the surgery before the advent of cardiac enlargement and pulmonary vascular congestion is well documented. A discriminating clinical evaluation and ready availability of Doppler ultrasound studies should allow this to be done in most instances. However, the case for routine placement of the currently available valve substitutes in adults who are truly asymptomatic is still difficult to support. A policy of operating on patients who are at an early asymptomatic stage, or occasionally on truly asymptomatic patients who have the most severe grade of aortic stenosis, should probably continue until better valve substitutes are available.

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Circulation. 1990;82:310-312
doi: 10.1161/01.CIR.82.1.310

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1990 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/82/1/310.citation

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