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Do Patients in Congestive Cardiac Failure Undergoing Cardiac Surgery Demonstrate Worse Outcomes Compared with Those with a History of Cardiac Failure?

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ABSTRACT

Objectives: Cardiac surgery in patients with symptoms of congestive cardiac failure (CCF) carries a significant risk of mortality and morbidity. Except for emergencies and in unstable cases, the recommendation has been to delay the operation until the patient is fully recovered. The objective of this study was to determine the consequences of cardiac surgery in patients with acute decompensated heart failure and to compare their outcomes with the results of the operation in patients with previous CCF.

Methods: We compared the outcomes of patients with CCF (n = 707) at the time of cardiac surgery (valve replacement or coronary artery bypass grafting [CABG]) with those with a history of CCF (n = 1583). The EuroSCORE was significantly higher in CCF patients ($P < .001$). Impaired renal function was also more commonly observed in patients with CCF ($P < .001$). After adjusting for preoperative characteristics, we compared the 2 groups with respect to postoperative complications, postoperative creatine kinase MB values, and in-hospital mortality.

Results: Before adjusting for preoperative characteristics, we found that in-hospital mortality (15.5%) and postoperative complications, such as arrhythmias (31%), renal failure (19%), stroke (4.7%), and myocardial infarction (MI) (3%), were significantly higher in the CCF group than in those with a previous history of CCF. When the patients were matched for preoperative characteristics, the rates of postoperative MI and arrhythmia were the main complications that were significantly higher in the CCF group, compared with the patients with previous CCF. The 2 groups were not significantly different with respect to in-hospital mortality. The results were not affected by the type of procedure (valve or CABG), and the main factor influencing mortality was the EuroSCORE.

Conclusion: Despite the significant risk of mortality and morbidity in patients with current CCF, cardiac surgery to reverse the cause should not be delayed in these patients, because doing so may lead to further deterioration. Other risk factors, however, should be taken into consideration on an individual basis.

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INTRODUCTION

Congestive cardiac failure (CCF) or heart failure (HF) is a structural or functional ventricular disorder that impairs the filling or ejection of blood [Hunt 2005], which leads to decreased blood supply to the body, fluid retention, and congestion. This condition has a gross impact on the quality of life and the survival prospects of the affected individuals. Over the past 2 decades, the number of patients dying of CCF has doubled, increasing the burden on the health care system and society [Koelling 2004]. CCF is a progressive disorder and may cause irreversible structural damages.

CCF is mainly a chronic condition and can be caused by ischemic heart disease (IHD), hypertension, idiopathic cardiomyopathy, and valvular heart disease [Hunt 2005]. It can present acutely in certain circumstances, such as myocardial infarction (MI) (with or without structural cardiac damage) and infective endocarditis, and produce acute decompensated HF (ADHF), resulting in signs and symptoms of HF and almost always leads to pulmonary or systemic congestion [Gheorghiade 2005].

ADHF is an indication for hospital admission and is usually treated with diuretics, vasodilators, and inotropes. The mortality rate reported for these patients after discharge has been as high as 20% [Solomon 2007]. Acute cardiovascular dysfunction has been reported to occur perioperatively in more than 20% of patients undergoing cardiac surgery [Koerner 2001]. Several studies have shown that cardiac surgery can be of great benefit for patients with CCF, especially if the cause is IHD [CASS 1983; Kaul 1996; Elefteriades 1997; Benetis 2005], and the postoperative mortality rate is reduced significantly with adequate myocardial protection and complete revascularization. Therefore, the benefits of a surgical approach over medical therapy have been demonstrated for CCF. The main question, however, relates to the optimal timing for surgery, especially in patients with ADHF. The general consensus is usually to wait until after the acute phase, because cardiac surgery in these patients carries a significant risk

of morbidity and mortality. Therefore, except for emergencies and in unstable cases, the recommendation has been for cardiac surgery to be delayed until the patient has recovered from the acute episode.

The objective of this study was to determine the consequences of cardiac surgery in patients with current CCF and to compare their outcomes with the results of surgery for patients with a history of previous CCF.

MATERIALS AND METHODS

Patient Population

In this retrospective study, we reviewed prospectively collected patient data for our institution during the 10-year period between 1999 and 2009. We included 2285 patients with a history of HF, past or present, who were to undergo cardiac surgery and divided them into 2 groups: group A (n = 704), patients who had ADHF at the time of cardiac surgery and had such symptoms as pulmonary edema, cardiogenic shock, or peripheral edema; and group B (n = 1581), patients who had a history of one or more episodes of ADHF but who had recovered from the acute phase. The patient details, the registry database, medical records, and the national death index were reviewed for both groups.

Table 1 summarizes the patient characteristics. The median age was 68.5 years (25th-75h percentiles, 60.7-75.2 years) and 69.6 years (25th-75th percentiles, 62.5-75.2 years) in group A and group B, respectively. The logistic EuroSCORE was significantly higher in group A than in group B ($P < .001$).

Operations

Various procedures were analyzed in 6 different groups: (1) isolated coronary artery bypass grafting (CABG), (2) aortic valve replacement (AVR), with or without CABG; (3) mitral valve replacement or repair (MVR), with or without CABG; (4) AVR plus MVR, with or without CABG; (5) ventricular septal defect closure, with or without CABG; and (6) other cardiac procedures, such as excision of myxoma and atrial septal defect closure (Table 2). Procedures such as pulmonary embolectomy, insertion of epicardial leads, or tricuspid valve surgery were excluded.

Statistical Analysis

All statistical analyses were performed retrospectively with SAS for Windows (version 8.2; SAS Institute, Cary, NC, USA). Continuous variables not normally distributed are presented as the median with the 25th and 75th percentiles. Categorical data are presented as percentages. Univariate comparisons were made with the Wilcoxon rank sum test and the chi-square test as appropriate. Deaths occurring over time were described with Kaplan-Meier survival curves [Kaplan 1958].

Table 1. Preoperative Characteristics*

	Unmatched			Matched		
	Current CCF (n = 704)	Past CCF (n = 1581)	*P*	Current CCF (n = 290)	Past CCF (n = 290)	*P*
Age at operation, y	68.5 (60.7-75.2)	69.6 (62.5-75.2)	.04	70.4 (64.2-76.1)	70.1 (63.8-75.4)	.59
Body mass index, kg/m^2	26.4 (23.9-30.4)	26.9 (24-30.4)	.45	27.9 (24.9-31.3)	28.2 (24.6-31.6)	.80
Female sex, %	36.4	40	.10	33.5	36.9	.38
Recent MI, %	18.3	7.5	<.001	16.6	20.0	.28
Current smoker, %	15.6	12.2	.03	13.8	12.8	.71
Diabetes, %	22.3	23.3	.59	28.3	33.5	.18
Hypercholesterolemia, %	58.4	66.8	<.001	79.7	80.7	.75
Hypertension, %	48.9	52.3	.13	66.2	69.3	.42
Respiratory disease, %	49.4	49.8	.86	51.7	49.7	.62
Cerebrovascular disease, %	12.2	14.9	.09	13.8	15.9	.48
Peripheral vascular disease, %	11.8	13.4	.29	17.2	20.0	.39
Renal dysfunction, %†	22	9.6	<.001	13.1	11.4	.53
Triple-vessel disease, %	38.2	42.1	.08	64.8	69.3	.25
Prior surgery, %	11.5	7.3	.001	3.1	3.1	>.99
Nonelective, %	59.5	17.1	<.001	44.5	45.5	.80
Salvage operation, %	3.4	0.1	<.001	1.0	0.0	.25
Logistic EuroSCORE	12.5 (6.1-28.9)	7.7 (4.1-15)	<.001	8.4 (4.1-19.4)	8.4 (4.6-19.4)	.69

*Continuous data are presented as the median (25th-75th percentiles) and analyzed with the Wilcoxon rank sum test. Categorical data are presented as percentages and analyzed with the chi-square test. CCF indicates congestive cardiac failure; MI, myocardial infarction.
†Creatinine >200 μmol/L.

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Table 2. Operative and Postoperative Characteristics*

	Unmatched			Matched		
	Current CCF (n = 704)	Past CCF (n = 1581)	*P*	Current CCF (n = 290)	Past CCF (n = 290)	*P*
Operative characteristics						
CABG, %	31.3	39.5	<.001	62.4	60.7	.67
AVR ± CABG, %	32.1	26.9	.01	25.5	23.8	.63
MVR ± CABG, %	19.5	23.9	.02	8.3	12.1	.13
AVR and MVR ± CABG, %	6.7	6.8	.89	3.1	3.1	>.99
VSD ± other, %	5.5	0.2	<.001	0.7	0.3	>.99
Other, %	5.0	2.8	.008	0.0	0.0	—
Preoperative IABP, %	14.9	1.1	<.001	4.5	5.2	.70
Postoperative complications						
Inotrope support, %	70.7	54.6	<.001	60.3	60.3	>.99
Intra-/postoperative IABP, %	9.5	4.8	<.001	10.0	9.3	.78
Ventilation >48 h, %	20	7.0	<.001	14.5	9.3	.054
Acute renal failure, %	18.9	11.3	<.001	19.0	14.4	.12
Surgical wound infection, %	5.0	4.1	.35	6.6	6.6	>.99
Atrial arrhythmia, %	30.7	25.4	.008	35.1	30.0	.19
Stroke, %	4.7	3.2	.07	5.2	3.5	.31
Reexploration for bleeding, %	8.0	5.4	.02	5.9	6.2	.86
Myocardial infarction, %	3.0	1.1	.002	4.9	0.7	.002
Outcome						
ICU LOS, d	6 (1-2)	1 (1-3)	<.001	2 (1-5)	2 (1-4)	.43
Postoperative LOS, d	10 (7-19)	9 (7-13)	<.001	10 (7-17)	9 (7-14)	.69
In-hospital mortality, %	15.5	5.9	<.001	12.4	8.6	.14

*Continuous data are presented as the median (25th-75th percentiles) and analyzed with the Wilcoxon rank sum test. Categorical data are presented as percentages and analyzed with the chi-square test. CCF indicates congestive cardiac failure; CABG, coronary artery bypass grafting; AVR, aortic valve replacement; MVR, mitral valve replacement or repair; VSD, ventricular septal defect; IABP, intra-aortic balloon pump; ICU, intensive care unit; LOS, length of stay.

To account for differences in the case mix, we developed a propensity score for HF group membership [Blackstone 2002]. We used multivariable logistic regression analysis [Hosmer 1989] to determine the propensity for membership in the ADHF group (group A) without regard to outcome. We developed a full nonparsimonious model that included all of the variables listed in Tables 1 and 2. The goal was to balance patient preoperative and operative characteristics by incorporating everything recorded that could relate to either systematic bias or simply bad luck. This model yielded a C statistic of 0.71, indicating an acceptable ability to differentiate between patients with or without ventricular dysfunction. We then used a macro (available at http://www2.sas.com/proceedings/sugi29/165-29.pdf) to perform propensity matching. After propensity matching, the outcomes of the 290 cases remaining in each group were compared. In all cases, a *P* value <.05 was considered statistically significant.

RESULTS

Operations

Prior to the matching for the preoperative and operative characteristics, there were significant differences between the 2 groups in the types of the operations. More isolated CABG procedures and procedures of MVR with or without CABG were performed in patients with previous CCF, whereas procedures consisting AVR with or without CABG were more common in the ADHF patients than in the patients who had previous CCF. Nonelective cases constituted 59.5% of the patients in group A (with acute CCF), compared with the 17.1% in group B ($P < .001$). The frequency of redo procedures in the ADHF group (11.5%) was also higher than in the group with previous CCF (7.3%). In addition, preoperative use of an intra-aortic balloon pump (IABP) was significantly higher in the ADHF group (14.9%) than in the patients with previous CCF (1.1%). The type of procedure, nonelective cases, and redo operations were also taken into consideration for propensity matching.

Table 3. Survival Rate*

	Unmatched			Matched		
	Current CCF (n = 704)	Past CCF (n = 1581)	*P*	Current CCF (n = 290)	Past CCF (n = 290)	*P*
30-Day mortality, %	13.2	5.4	<.001	10.7	7.2	.15
5-Year mortality, %	31.8	23.6	<.001	29.0	28.3	.85
10-Year mortality, %	37.9	30.7	<.001	36.2	36.2	>.99

*Categorical data are presented as percentages and analyzed with the chi-square test. CCF indicates congestive cardiac failure.

Postoperative Course

Prior to adjustment for preoperative and operative characteristics, the percentage of patients requiring postoperative inotropic support and IABP use was significantly higher in group A (70.7% and 9.5%, respectively) than in group B (54.6% and 4.8%). Ventilation times, intensive care unit, and hospital stays were all significantly higher in the ADHF group than in the group with previous CCF ($P < .001$). Furthermore, the rate of reexploration for bleeding was significantly higher in the ADHF group (group A) than in group B (8% versus 5.4%); however, the 2 groups were not different with respect to the amount of blood loss through the mediastinal and pleural drains. This finding suggests a lower threshold for reexploration in group A compared with group B ($P = .02$).

After adjusting for the preoperative and operative characteristics, we observed no difference between the 2 groups in inotrope and IABP requirements or in the rate of reexploration. Ventilation time was prolonged in group A compared with group B, but the difference did not reach statistical significance. The 2 groups were also similar with respect to the lengths of intensive care unit and hospital stays.

Postoperative Complications

Compared with group B, group A had significantly higher rates of complications such as renal failure (18.9% versus 11.3%), postoperative arrhythmia (30.7% versus 25.4%), and MI (3% versus 1.1%) (*P* values <.05). On the other hand, groups A and B showed no statistically significant differences in the incidence of stroke (4.7% versus 3.2%) and surgical wound infection (5% versus 4.1%). After adjustment of groups A and B for the preoperative characteristics, both groups had similar rates of complications, except for the significantly higher incidence of MI in group A (4.4% versus 0.7%; see Table 2).

In-Hospital Mortality

In-hospital mortality was significantly higher in acute cases (group A) than in group B (15.5% versus 5.9%); however, after adjustment for preoperative and operative characteristics, no difference between the 2 groups was identified ($P = .14$).

Early, Medium-term, and Long-term Survival Rates

Before adjustment for preoperative characteristics, early (30-day), medium-term (5-year) and long-term (10 year) survival rates were significantly lower in the patients with ADHF. After matching for the preoperative and operative characteristics, however, the 2 groups showed no difference in survival rate (Table 3).

DISCUSSION

CCF is mainly a chronic condition. Different causes have been identified for the development of CCF. It can be due to infection (cardiomyopathy/myocarditis/endocarditis), it can be due to structural/chronic cardiac disease, or it can be idiopathic. Some patients also present with symptoms related to acute HF for which there is a surgically reversible cause, such as MI, infective endocarditis, and valvular heart disease. Surgery is usually postponed or delayed for patients with ADHF, either because of late cardiologic referral or because the cardiac surgeons have postponed surgery. In many cases, the general belief is that cardiac surgery in the acute stage can increase the incidence of postoperative complications and mortality. Therefore, except in cases of emergencies and salvage procedures, heart surgery is delayed until the patient has recovered from the acute episode. After treating such patients conservatively, however, the reported mortality rate prior to surgery is still as high as 20% [Solomon 2007].

It is important to identify whether CCF is the result or the cause of any cardiac pathology, such as IHD, aortic valve disease, or mitral valve disease. If CCF is due to such conditions as aortic stenosis, mitral regurgitation, and IHD, an early operation can reverse the structural and ongoing damage to the cardiac muscle. On the other hand, cardiac failure that is due to an organic or structural cardiac muscle problem can produce such conditions as aortic valve insufficiency or mitral valve regurgitation, which can subsequently start a vicious cycle that exacerbates the CCF. In these circumstances, an operation can prevent further deterioration of HF. Several studies have shown that cardiac surgery has great benefit in patients with CCF, especially if the cause is IHD [CASS 1983; Kaul 1996; Elefteriades 1997; Benetis 2005]. The timing of such surgery remains unclear, however. Furthermore, despite the superiority of surgery to medical therapy, some authors have shown a decreased benefit for CABG soon after an acute MI [Lee 2001]; however, most of these authors did not specify the percentage of patients who had ADHF due to acute MI at the time of surgery.

In this report we have shown that patients in ADHF do have a higher incidence of postoperative mortality and a demonstrated worse outcome compared with patients who had experienced a previous event. When we matched these

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groups for their preoperative and operative characteristics, however, the 2 groups did not differ with respect to surgical outcome and even survival rate. These findings indicate that ADHF is not a contraindication to cardiac surgery. When such patients are reviewed, their overall risk factors and preoperative comorbidities should be taken into consideration before deciding to proceed or delay surgical intervention. This recommendation does not mean that patients who have had a recent acute MI and are in HF are always suitable candidates for surgery, but postponing surgical intervention may not be desirable either. Indeed, a delay can lead to deterioration that produces a higher incidence of postoperative complications and mortality.

The main limitation of this study is its retrospective nature. More importantly, the diagnosis of HF, which was made by the cardiologist, the surgeon, and the anesthetist, was based on clinical and echocardiographic findings. In addition, the exact interval between a previous event and performing cardiac surgery was not taken into consideration; therefore, this study does not allow us to comment on the optimal time of surgery after an event. It does, however, demonstrate that ADHF patients may not have a worse outcome than patients who have recovered from an ADHF. Identifying the optimal timing of surgery for patients with present or previous ADHF requires randomized controlled trials.

We conclude that individual preoperative assessment of patients with risk stratification remains the most important factor in justifying the optimal timing of surgical intervention after a current or previous episode of HF. In other words, our results suggest that ADHF per se is not a contraindication to cardiac surgery.

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