

The effect of mild left ventricular diastolic dysfunction on outcome after isolated coronary bypass surgery

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Abstract

Background: Although moderate to severe diastolic dysfunction (DD) seems to be associated with poor prognosis after isolated coronary bypass surgery, the impact of mild DD has not been investigated extensively in this group of patients.

Aim: We evaluated the prognostic implication of mild left ventricular (LV) DD on outcome after isolated coronary bypass surgery in patients with preserved LV systolic function.

Methods: Data from 650 patients undergoing isolated coronary bypass surgery and having records for LV diastolic function between January 2009 and August 2011 was collected retrospectively. DD was classified as mild (grade 1, impaired relaxation), moderate (grade 2, decreased compliance) or severe (grade 3–4, restrictive pattern) depending on mitral inflow wave, tissue Doppler imaging, and pulmonary vein flow wave. Patients with baseline rhythm other than sinus, moderate or severe valvular dysfunction, moderate or severe diastolic dysfunction, and LV ejection fraction lower than 50% were excluded. A total of 472 patients were identified within the database fulfilling the eligibility criteria for this analysis and stratified according to the echocardiographic findings as follows: group 1 comprised patients with normal diastolic function (n = 168); and group 2 was made up of patients with mild DD (impaired relaxation) (n = 304). These groups were compared for perioperative morbidity and mortality.

Results: The preoperative variables were comparable between groups. The outcome parameters of group 1 was similar compared to group 2 in terms of need for inotropic support (20.2% vs. 16.2%), intra-aortic balloon pump usage (0% vs. 1.4%), mechanical ventilation time (8.94 ± 0.96 h vs. 10.0 ± 0.89 h), reintubation rate (1.8% vs. 1.4%), intensive care unit stay time (24.1 ± 1.4 h vs. 26.2 ± 1.9 h), postoperative renal failure rate (0% vs. 0.3%), postoperative atrial fibrillation rate (10.1% vs. 11.2%), length of hospital stay (7.19 ± 0.45 vs. 6.57 ± 0.14 days), hospital readmission rate (3.1% vs. 3.1%), and mortality (0% vs. 1.6%).

Conclusions: The results from this study indicate that mild LV DD is not associated with adverse outcome after coronary bypass surgery in patients with preserved LV systolic function, thus should not be considered as a preoperative risk factor.

Key words: coronary bypass, diastolic dysfunction, outcome

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INTRODUCTION

Left ventricular (LV) diastolic function has an important implication in evaluating heart disease [1]. It has a prognostic significance in heart failure [2–6] and reflects accurately the

clinical functional status of patients with heart failure [7, 8], but its significance is not clear enough in patients undergoing coronary artery bypass grafting (CABG) surgery. A strong relation between increased LV end diastolic pressure (LVEDP)

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and early mortality after cardiac surgery has been reported [9, 10]. Additionally, there have been several clinical studies that have shown moderate and severe diastolic dysfunction (DD) associated with worse prognosis [11, 12]. The degree of DD is correlated with LVEDP [13] and moderate and severe dysfunction is associated with elevated pressure, while mild dysfunction is not. Recent studies have concluded that LVEDP and severe DD is an important variable in predicting postoperative outcome and therefore should be incorporated in surgical risk models [14, 15]. However, DD is often mild in patients undergoing CABG [15], and the effect of mild DD has not been completely investigated in this group of patients. For this reason, we aimed to investigate the effect of mild DD on outcome after CABG in patients with preserved LV systolic function.

METHODS

Patients

The records for LV diastolic function were available for 650 patients who had undergone isolated CABG between January 2009 and August 2011. The local ethics committee approved the investigational protocol described herein. Patients with baseline rhythm other than sinus ($n = 37$), moderate or severe valvular dysfunction ($n = 38$), and LV ejection fraction lower than 50% ($n = 73$) were excluded. Patients with moderate or severe DD ($n = 30$) were also excluded both because of an inadequate number to make a reliable statistical analysis and coexisting reduced LV systolic function in the huge majority of these patients. A total of 472 patients were identified within the database that fulfilled the eligibility criteria for this analysis.

Evaluation of the diastolic function

Diastolic function was evaluated routinely by using mitral inflow waves, tissue Doppler imaging (TDI) and pulmonary vein flow waves analysis with echocardiography. DD was classified as mild (grade 1, impaired relaxation), moderate (grade 2, decreased compliance) or severe (grade 3–4, restrictive pattern) as indicated in the 2009 recommendations for the evaluation of LV diastolic function [16]. Normal E' value (> 10 cm/s), evaluated by TDI and measured from LV lateral wall, and presence of E/A ratio > 1 , evaluated by mitral inflow waves were considered as normal diastolic function. Decreased E' value (< 10 cm/s) and E/A ratio < 0.8 were considered as grade 1 DD.

Data collection and statistical analysis

Data was collected on the following variables: patient age and sex, body mass index, LV ejection fraction, smoking history, presence of comorbid disease, urgency of operation, previous cardiac surgery, Euroscore, logistic Euroscore, cardiopulmonary by-pass time, and number of grafts performed. The variables were chosen based on a review on the literature and on the experience of the clinicians in the research group. The

Table 1. Clinical and operative data

	Normal diastolic function (n = 168)	Mild diastolic dysfunction (n = 304)	P
Mean age [years]	58.1 ± 0.76	62.4 ± 0.54	NS
Female gender	34 (20.2%)	81 (26.6%)	NS
Body mass index [kg/m ²]	29.08 ± 4.27	29.14 ± 4.42	NS
Ejection fraction	62.2 ± 0.29	61.1 ± 0.41	NS
Previous cardiac surgery	4 (2.4%)	8 (2.7%)	NS
Non-elective surgery	22 (13.2%)	23 (7.6%)	NS
Hypertension	120 (71.4%)	245 (80.6%)	0.02
Diabetes mellitus	59 (35.1%)	129 (42.9%)	NS
Chronic obstructive pulmonary disease	11 (6.5%)	16 (5.3%)	NS
Renal disease	8 (4.8%)	24 (7.9%)	NS
Peripheral vascular disease	9 (5.4%)	43 (14.1%)	0.003
Logistic score	2.37 ± 0.21	2.63 ± 0.13	NS
Left main disease (> 50%)	17 (10.6%)	23 (8.0%)	NS
Mean number of grafts	3.13 ± 0.09	3.07 ± 0.05	NS
Cardiopulmonary bypass time [min]	65.1 ± 1.7	65.7 ± 1.4	NS
Cross-clamp time [min]	36.7 ± 1.0	36.8 ± 0.7	NS

endpoints were a need for perioperative inotropic support (defined as giving inotropic medication for more than 4 h) or intra-aortic balloon pump, the development of postoperative atrial fibrillation, acute renal failure (index hospitalisation), length of hospital stay and mortality (index hospitalisation or first 30 days).

All data was extracted from the institutional database and reported as a percentage or as a mean ± standard deviation. Categorical variables were compared using the χ^2 or Fisher's exact test and continuous variables with Student's t tests. Statistical analysis was performed using SPSS statistical software (SPSS version 11.0, SPSS Inc, Chicago, IL, USA). Variables were considered significant at p values less than 0.05. As univariate analysis did not reveal any significant differences between the two groups, no further attempt was made to make risk adjustment or multivariate analysis.

RESULTS

A total of 472 patients were identified as fulfilling the eligibility criteria, and these patients were stratified according to the echocardiographic findings as follows; group 1, patients with normal diastolic function ($n = 168$), and group 2, patients with mild DD (impaired relaxation) ($n = 304$). Table 1 demonstrates the demographic characteristics and operative data. The two groups were comparable except for incidence of

Table 2. Postoperative events

	Normal diastolic function (n = 168)	Mild diastolic dysfunction (n = 304)	P
Need for inotropic support	33 (20.2%)	48 (16.2%)	NS
Need for intra-aortic balloon pump support	0 (0%)	4 (1.4%)	NS
Intubation time [h]	8.94 ± 0.96	10.0 ± 0.89	NS
Reintubation	3 (1.8%)	4 (1.4%)	NS
Intensive care unit stay time [h]	24.1 ± 1.4	26.2 ± 1.9	NS
Postoperative acute renal failure	0 (0%)	1 (0.3%)	NS
Postoperative atrial fibrillation	17 (10.1%)	34 (11.2%)	NS
Hospital stay time [days]	7.19 ± 0.45	6.57 ± 0.14	NS
Hospital readmission	5 (3.1%)	9 (3.1%)	NS
Mortality	0 (0%)	5 (1.6%)	NS

hypertension, angiotensin converting enzyme inhibitors (ACEI) use, and peripheral vascular disease, which were more common in patients with DD. Outcome parameters are shown in Table 2. No significant difference was found between the two groups with regards to outcome parameters.

DISCUSSION

The results from this study indicate that mild DD, which normally correlates with normal LV diastolic pressure, is not associated with increased mortality and morbidity after CABG.

The demographic variables in our study are consistent with the known relationship of DD between hypertension and atherosclerotic vascular disease. Using ACEI is more common in patients with DD probably due to the high incidence of hypertension.

Prognostic value of the diastolic function has already been demonstrated in patients with a variety of cardiac diseases [2, 17–21] and it is also known that DD is associated with many conditions, such as ageing, history of myocardial infarction, diabetes mellitus, low ejection fraction and renal dysfunction, which increase postoperative risk [22]. However, the impact of DD on outcome after CABG has not been fully studied. Many risk factors have been included in classic risk scoring systems in cardiac surgery, but none of these systems integrated DD as a risk factor so far because of the insufficient number of clinical trials and probably the uncertain effect of various degrees of DD.

Several studies have evaluated the prognostic significance of DD after cardiac surgery and it has been linked to an increased incidence of postoperative complications [11, 12, 23, 24]. All of these studies revealed that outcome correlated with severity of DD.

Vaskelyte et al. [11] demonstrated that restrictive LV filling pattern is associated with increased postoperative mortality and morbidity. On the other hand, Merello et al. [12] showed that severe DD is a strong independent predictor of adverse

outcome and therefore it should be accepted as an important variable in the risk stratification systems. Afilalo et al. [15] also demonstrated that severe DD was found to be a predictor of mortality or major morbidity after CABG. The degree of DD is correlated with end diastolic pressure [13] and studies demonstrated that increased filling pressures correlate with operative mortality in patients undergoing cardiac surgery [9, 10, 14, 25]. Therefore, it has been suggested that DD with elevated LVEDP has a predictive value for outcome following CABG surgery and may improve the predictive accuracy of the Euroscore [14].

However, mild DD has not been evaluated extensively and it is common in patients undergoing CABG in clinical practice. In one small retrospective study, it was suggested that impaired relaxation may be an important factor in the surgical outcome in patients who underwent CABG. Overall complication was observed slightly more often in patients with impaired relaxation compared to normal patients, but when each complication or mortality is compared in two groups, there was no significant difference [26].

While DD with elevated LV diastolic pressure can predispose to increased perioperative mortality and morbidity, our study revealed that mild DD, with normal filling pressure, does not seem to be a predictor of adverse outcome after CABG in patients with normal LV ejection. Elevated LV diastolic pressure is usually associated with reduced LV ejection fraction and increased pulmonary pressure, which are well known risk factors for cardiac surgery [9, 27]. Additionally, increased filling pressure may impair subendocardial perfusion and may also lead to the patient being sensitive to the volume changes, which is common in the perioperative setting. All these changes may be associated with reduced cardiac output and haemodynamic instability in the critical perioperative period. On the other hand, normal filling pressure can be associated with better haemodynamic profile. It is also observed that individuals with increased LVEDP (> 22 mm Hg) had an

approximately two-fold increase in risk compared to normal LVEDP (< 14 mm Hg) [9].

Limitations of the study

The main limitations of this study are its retrospective nature and lack of comparison with more severe DD, which would be needed to more precisely identify the additive impact of DD severity on surgical outcome in patients with normal LV systolic function.

CONCLUSIONS

Preoperative evaluation of the diastolic function, which has an important implication in the assessment of the surgical outcome and prognosis, seems to be correlated with severity of DD. However, mild DD (impaired relaxation) is not associated with adverse outcome in patients with preserved LV systolic function.

Conflict of interest: none declared

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Wpływ łagodnej dysfunkcji rozkurczowej lewej komory na wyniki leczenia po izolowanym pomostowaniu aortalno-wieńcowym

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Streszczenie

Wstęp: Mimo że umiarkowana i ciężka niewydolność rozkurczowa wiąże się z niekorzystnym rokowaniem po izolowanym pomostowaniu aortalno-wieńcowym, nie przebadano dokładnie wpływu łagodnej dysfunkcji rozkurczowej u chorych poddanych temu zabiegowi.

Cel: Badanie przeprowadzono w celu oceny implikacji rokowniczych łagodnej dysfunkcji rozkurczowej lewej komory (LV) w odniesieniu do wyników leczenia po zabiegu izolowanego pomostowania aortalno-wieńcowego u chorych z zachowaną czynnością skurczową LV.

Metody: W sposób retrospektywny zebrano dane 650 chorych poddanych izolowanemu pomostowaniu aortalno-wieńcowemu, u których dostępne były wyniki badań potwierdzające dysfunkcję rozkurczową LV z okresu od stycznia 2009 r. do sierpnia 2011 r. Dysfunkcję rozkurczową klasyfikowano jako łagodną (stopnia 1., upośledzona relaksacja), umiarkowaną (stopnia 2., zmniejszona podatność) lub ciężką (stopnia 3.–4., o charakterze restrykcyjnym) w zależności od: fali napływu mitralnego, wyników obrazowania z zastosowaniem doplera tkankowego i przepływu w żyłę płucnej. Chorych z rytmem podstawowym serca innym niż zatokowy, z umiarkowaną lub ciężką dysfunkcją zastawek, umiarkowanym lub ciężkim zaburzeniem czynności skurczowej i frakcją wyrzutową LV < 50% wykluczono z badania. Kryteria włączenia do analizy spełniało łącznie 472 pacjentów. Podzielono ich na dwie grupy w zależności od rezultatów badania echokardiograficznego: grupa 1 obejmowała chorych z prawidłową czynnością rozkurczową (n = 168), a w grupie 2 znalazły się osoby z łagodną dysfunkcją rozkurczową (upośledzona relaksacja) (n = 304). Grupy te porównano pod względem chorobowości i śmiertelności po zabiegu.

Wyniki: Parametry wyjściowe, sprzed zabiegu, były porównywalne w obu grupach. Następujące zmienne dotyczące wyników leczenia były podobne w grupie 1 i 2: konieczność stosowania leków o działaniu inotropowym dodatnim (20,2% vs. 16,2%), stosowanie wewnątrzaoortalnej kontrapulsacji balonowej (0% vs. 1,4%), czas stosowania wentylacji mechanicznej [h] (8,94 ± 0,96 vs. 10,0 ± 0,89), częstość ponownej intubacji (1,8% vs. 1,4%), czas pobytu na oddziale intensywnej opieki medycznej [h] (24,1 ± 1,4 vs. 26,2 ± 1,9), częstość pooperacyjnej niewydolności nerek (0% vs. 0,3%), częstość migotania przedsionków w okresie pooperacyjnym (10,1% vs. 11,2%), czas pobytu w szpitalu [dni] (7,19 ± 0,45 vs. 6,57 ± 0,14), częstość ponownych hospitalizacji (3,1% vs. 3,1%), śmiertelność (0% vs. 1,6%).

Wnioski: Łagodna dysfunkcja rozkurczowa LV nie wiąże się z niekorzystnymi wynikami leczenia po pomostowaniu aortalno-wieńcowym u chorych z zachowaną frakcją wyrzutową LV, dlatego też nie jest czynnikiem, który należy uwzględnić w przedoperacyjnej ocenie ryzyka.

Słowa kluczowe: pomostowanie aortalno-wieńcowe, dysfunkcja rozkurczowa, wynik leczenia

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