*Original Article*

# The Effect of Extracorporeal Circulation and Cross-Clamping Period on Erectile Dysfunction in Cardiac Surgical Patients: One-Year Follow-Up Study

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***Background:*** Erectile dysfunction [ED] can impact the quality of life. Thus, it is crucial to know the erectile function in patients who underwent cardiac surgery.

***Objective:*** To investigate the factors influencing ED in the patients with cardiac surgery.

***Materials and Methods:*** A one-year follow-up study of patients that underwent cardiopulmonary bypass [CPB] in Phramongkutklao Hospital was conducted. A self-administered questionnaire including International Index of Erectile Function [IIEF]-5 was provided and collected at preoperative, 6-, and 12-month postoperative periods. Discrete variables were analyzed by Chi-square test and continuous variables were analyzed by paired or unpaired t-test. Statistical significance was defined as *p*-value lower than 0.05.

***Results:*** Three hundred thirty-three males (mean age 58.0±14.2) were enrolled. Of these, the procedures were performed as follow, 45% CABG, 6% CABG with valvular heart surgery, 41% valvular heart surgery, 3% congenital heart surgery, and 5% others. The prevalence of ED significantly decreased after the operation with the prevalence of 91.6%, 84.1%, and 79.5% at preoperative, 6-, and 12-month postoperative periods, respectively ($p<0.001$). The IIEF-5 score was significantly increased from 11.9±7.5 preoperatively to 12.7±7.9 and 13.2±8.3 at 6- and 12-month postoperative periods, respectively ($p<0.05$). Advanced age, smoking, alcohol consumption, hypertension, diabetes mellitus, chronic kidney disease, and β-blocker use were risk factors associated with ED. In contrast, the CPB and the aortic cross-clamping period were not associated with ED.

***Conclusion:*** ED prevalence decreased after cardiac surgery possibly resulting from the improvement of the cardiac function and psychological and physical status after surgery.

***Keywords:*** ED, Cardiac surgery, IIEF-5, CPB, Thailand

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One of the sexual activities before and after cardiac surgery commonly asked by male patients is Erectile Dysfunction [ED], which could impact them and their partners' quality of life. The answer to this is still unconfirmed. The etiology once was considered to be mainly psychogenic[1,2]. However, because of advance in the understanding of the physiology of erection and the development of modern diagnostic techniques, it is now generally agreed that in most patients, ED is due to organic causes. Most organic causes are associated with vascular diseases, because the cavernous arteries resemble the coronary arteries as they are end arteries without collateral circulation. Therefore, vasculogenic ED may be a result of a coronary artery disease[3]. The aim of this one-year follow-up prospective study was to investigate male cardiac surgical patients regarding to the effects of extracorporeal circulation period, cross-clamping period, and other associated variables that were risk factors of ED.

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## Materials and Methods

### *Study population*

Between June 2010 and June 2011, 333 male patients that underwent cardiac surgery using cardiopulmonary bypass [CPB] in Phramongkutklao Hospital were enrolled in the present study. The prevalence was calculated from Lawson et al[4]. The total sample size was 385 patients.

### *Inclusion criteria*

Male patients undergoing elective cardiac surgery (coronary artery bypass graft [CABG] only, CABG

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with valvular heart surgery, valvular heart surgery only, congenital heart surgery, and other cardiac surgeries), age was older than 18 years, no history of cardiac intervention except cardiac catheterization, and had stable partners were included in the present study.

### *Exclusion criteria*

Patient whose diagnosis was ED and had previous treatment of ED before cardiac surgery, and diseases or surgeries procedure that could alter sexual activity such as renal failure, thyroid disease, and chronic liver disease, previous pelvic, penile, urethral, or prostate surgery were excluded. Patients underwent coronary angioplasty and patients who had other surgery interventions such as valve replacement or applying a pacemaker during the surgery were also excluded.

All patients had a normal routine preoperative evaluation including physical examination, laboratory testing (complete blood count, electrolyte, liver function test, blood urea nitrogen, creatinine, coagulogram, anti-HIV, chest X-ray), and no contraindication of surgery. Assessment was done by an abridged, 5-item version multidimensional validated questionnaire approved by the National Institutes of Health [NIH], USA[5-9]. Before the operation, patients were interviewed for ED using the International Index of Erectile Function [IIEF]-5. The IIEF-5 is a diagnostic tool for ED[10-13]. In Thailand, the IIEF-5 was translated into Thai by the Thai Urological Association. This questionnaire consisted of five questions to evaluate erectile function, orgasmic function, sexual desire, and intercourse satisfaction. Scoring the IIEF-5 domain of erectile function allowed the classification of each patient as having no (22 to 25), mild (17 to 21), mild to moderate (12 to 16), moderate (8 to 11), and severe (5 to 7) ED. Designed self-administration questionnaires including the IIEF-5 were provided and collected at preoperative, 6-, and 12-month postoperative periods. At the same visit, when they were assessed for ED, all patients were also interviewed for sociodemographic and relevant medical history. Sociodemographic data included age, job, marital status, alcohol consumption, narcotics use, and smoking habit. Medical risk factors included diabetes mellitus [DM], hypertension, and psychiatric disorders. Total bypass time and aortic cross-clamping time during the cardiac surgery were recorded.

### *Statistical analysis*

Discrete variables were analyzed using Chi-square test (marital status, education), continuous variables were analyzed by paired or unpaired t-test as appropriated (ED score) and univariate and multivariate analysis were applied for risk factors using logistic regression. Statistical analysis was conducted in Stata, version Stata statistical software, Release 13.1 (College station, TX, USA: StataCorp LP). The *p*-values were two-tailed with a significance level of 0.05.

## Results

For a cohort of 333 males (mean age 58.97±14.15), marital status comprised of 25 (7.5%) single, 275 (82.6%) married, and 33 (9.9%) widowed or divorced. Education levels were 240 (72.3%) at high school or lower, 79 (23.7%) at bachelor's degree, and 13 (3.9%) at postgraduate level. The median (IQR) of income per month was 12,500 (7,500 to 22,500) baht (Table 1).

The types of cardiac surgery procedures performed included CABG only 45%, CABG with valvular heart surgery 6%, valvular heart surgery only 41%, congenital heart surgery 3%, and other cardiac surgeries 5%. A comparison of the prevalence of ED at preoperative, 6-, and 12-month postoperative periods showed that the ED decreased over time. The total prevalence demonstrated 91.6%, 84.1%, and 79.5% at preoperative, 6-, and 12-month postoperative periods, respectively with statistical significance (*p*-value <0.001). No significant difference was found in sexual frequency (Table 2).

According to the present study, the patients started to have sex at the second month after surgery. The

**Table 1.** General characteristics of cardiac surgery patient in Phramongkutklao Hospital (n = 333)

| Characteristics | Results |
|---|---|
| Age (years), mean ± SD | 58.97±14.15 |
| Marital status, n (%) | |
| Single | 25 (7.5) |
| Married | 275 (82.6) |
| Widowed/divorce | 33 (9.9) |
| Education levels, n (%) | |
| High school level or lower (12 years) | 240 (72.3) |
| Bachelor level | 79 (23.7) |
| Post-graduation level | 13 (3.9) |
| Income per month (Thai baht), median (IQR) | 12,500 (7,500 to 22,500) |

**Table 2.** Prevalence of erectile dysfunction and frequency of sexual activity

| Time | Pre-operative | Post-operative | |
|---|---|---|---|
| | | 6 months | 12 months |
| Prevalence*, n (%) | 305 (91.6) | 280 (84.1) | 246 (79.5) |
| Frequency of sexual practice (/week), median (IQR) | 1 (0 to 1) | 1 (0 to 1) | 1 (0 to 2) |

* Chi-square test (*p*-value <0.001)

**Table 3.** Mean of IIEF-5 score by time

| Types of cardiac surgery | Pre-operative mean ± SD | Post-operative mean ± SD | |
|---|---|---|---|
| | | 6 months | 12 months |
| CABG only | 10.1±7.6 | 10.9±7.9 | 11.3±8.4 |
| CABG with valvular heart disease | 8.5±7.1 | 9.9±8.0 | 11.2±8.5 |
| Valvular heart disease only | 13.6±6.9 | 14.2±7.5 | 14.6±7.8 |
| Congenital heart disease | 16.7±7.8 | 18.5±7.2 | 19.5±6.5 |
| Others cardiac surgery | 13.6±6.4 | 14.7±7.6 | 15.5±7.8 |
| Total | 11.9±7.5 | 12.7±7.9 | 13.2±8.3* |

IIEF = International Index of Erectile Function; CABG = coronary artery bypass graft

* t-test pre-op and 12 months post-operative (*p*-value 0.037)

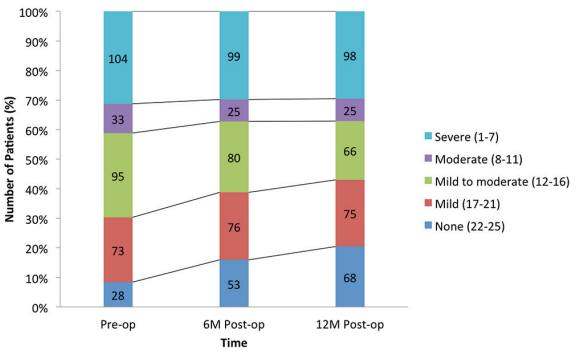


**Figure 1.** Proportion of ED severity by time.

IIFE-5 score increased from 11.89±7.49 preoperatively to 12.69±7.90 and 13.17±8.28 in 6- and 12-month postoperative periods, respectively, with statistical significance (*p*-value <0.05) (Table 3). The percentage with no ED increased 12% from preoperative to 12-month postoperative time as shown by the blue color bar (Figure 1).

From Table 4 and 5, the confounding factors were controlled using multivariate logistic regression and among the factors that influenced ED, advanced age, smoking, alcohol consumption, hypertension, DM, chronic kidney disease, and beta-blocker use were found to be the risk factors associated with increased ED while the extracorporeal circulation period and the aortic cross-clamping period were not.

## Discussion

ED has multiple causes including vascular status, neurological function, psychological factors, and comorbidity. Men with structural heart disease and medically refractory angina have a particularly high prevalence of ED because of cardiac dysfunction, exertional angina, psychological factors, and co-

**Table 4.** Factor influence ED

| Factors | Erectile dysfunction, n (%) | | | *p*-value |
|---|---|---|---|---|
| | Yes (IIEF <22) n = 264 | No (IIEF ≥22) n = 68 | Total | |
| Cigarette smoking | | | | <0.001 |
| Yes | 245 (92.8) | 47 (69.1) | 292 (88.0) | |
| No | 19 (7.2) | 21 (30.9) | 40 (12.0) | |
| Alcohol drinking | | | | <0.001 |
| Yes | 204 (77.3) | 24 (35.3) | 228 (68.7) | |
| No | 60 (22.7) | 44 (64.7) | 104 (31.3) | |
| Body mass index | | n = 67 | | 0.208 |
| Underweight | 15 (5.7) | 4 (6.0) | 19 (5.7) | |
| Normal | 138 (52.3) | 40 (59.7) | 178 (53.8) | |
| Overweight | 89 (33.7) | 22 (32.8) | 111 (33.5) | |
| Obesity | 22 (8.3) | 1 (1.5) | 23 (6.9) | |
| Hypertension | | | | 0.002 |
| Yes | 204 (77.3) | 39 (57.4) | 243 (73.2) | |
| No | 60 (22.7) | 29 (42.6) | 89 (26.8) | |
| Diabetes mellitus | | | | 0.004 |
| Yes | 69 (26.1) | 6 (8.8) | 75 (22.6) | |
| No | 195 (73.9) | 62 (91.2) | 257 (77.4) | |
| Dyslipidemia | | | | 0.380 |
| Yes | 145 (54.9) | 42 (61.8) | 187 (56.3) | |
| No | 119 (45.1) | 26 (38.2) | 145 (43.7) | |
| Beta-blocker use | n = 243 | n = 64 | | <0.001 |
| Yes | 119 (49.0) | 15 (23.4) | 134 (43.6) | |
| No | 124 (51.0) | 49 (76.6) | 173 (56.4) | |
| Chronic kidney disease | | | | <0.001 |
| Yes | 101 (38.3) | 8 (11.8) | 109 (32.8) | |
| No | 163 (61.7) | 60 (88.2) | 223 (67.2) | |
| Ejection fraction <50 | | | | 0.359 |
| Yes | 67 (25.4) | 13 (19.1) | 80 (24.1) | |
| No | 197 (74.6) | 55 (80.9) | 252 (75.9) | |
| Bypass time >151 | n = 263 | | | 0.913 |
| Yes | 66 (25.1) | 16 (23.5) | 82 (24.8) | |
| No | 197 (74.9) | 52 (76.5) | 249 (75.2) | |
| Aortic clamp time >110 | n = 263 | | | 0.931 |
| Yes | 62 (23.6) | 17 (25.0) | 79 (23.9) | |
| No | 201 (76.4) | 51 (75.0) | 252 (76.1) | |

Significant at *p*-value <0.05

morbidities including a high prevalence of peripheral vascular disease and DM. They also have special challenges including a need for nitrates, beta-blockers, and blood pressure control medications, which may exacerbate the ED.

ED is defined as the recurrent or persistent inability to achieve an erection to maintain satisfactory intercourse. Its prevalence in the general population is 19% to 52%[14]. Impotence and cardiovascular disease are risk factors previously reported by several authors[14-19]. Gueglio et al claimed that aortic cross-clamping and extracorporeal circulation times did

**Table 5.** Multivariated analysis by logistic regression

| Risk factors | Adjusted odds ratio (95% CI) |
|---|---|
| Age (years): ref. <41 | |
| 41 to 50* | 4.47 (1.22 to 16.37) |
| 51 to 60* | 7.33 (1.97 to 27.30) |
| 61 to 70* | 29.65 (5.07 to 173.39) |
| >70* | 208.34 (16.49 to 2507.26) |
| Education level: ref. higher than bachelor | |
| High school | 2.80 (0.47 to 16.59) |
| Bachelor | 1.16 (0.19 to 7.09) |
| Cigarette smoking* | 3.99 (1.29 to 12.35) |
| Alcohol drinking* | 3.44 (1.56 to 7.57) |
| Body mass index: ref. = normal | |
| Underweight | 3.23 (0.56 to 18.72) |
| Overweight | 1.23 (0.53 to 2.86) |
| Obesity | 1.87 (0.20 to 17.69) |
| Hypertension | 1.11 (0.44 to 2.80) |
| Diabetes mellitus | 1.85 (0.53 to 6.45) |
| Dyslipidemia* | 2.56 (1.06 to 6.21) |
| Beta-blocker use* | 3.87 (1.62 to 9.27) |
| Chronic kidney disease | 0.88 (0.26 to 3.02) |
| Ejection fraction <50 | 1.15 (0.44 to 3.01) |
| Bypass time >151 minutes | 1.60 (0.37 to 6.98) |
| Aortic clamp time >110 minutes | 0.65 (0.15 to 2.81) |

* $p$-value <0.05

not appear to influence ED[20]. Likewise, no statistical relationship between erectile function and both cross-clamping and extracorporeal circulation times were found in the present study. However, the patients who at postoperative period improved or maintained the same erectile function had shorter cross-clamping and extracorporeal circulation times (less exposure to hypoperfusion). The patients who had improved erectile function could be due to increased functional cardiac capacity. It appeared that the factors influencing erectile function were not independent. The psychological aspect of cardiac patients could not be underestimated. After surgery, patients may be afraid of having sexual activity because of possible adverse effects on the heart[21]. These factors influenced erectile function. In contrast, patients may have improved erectile function due to increased functional cardiac capacity. The limitation of the present study was the small patient population of erectile function. Prospective studies of larger numbers are required to assess the impact of CPB on erectile function.

## Conclusion

The authors found that risk factors associated with increase in ED included old age, smoking, alcohol consumption, dyslipidemia, and beta-blocker use. The CPB time and aortic cross-clamping time had no effect on ED.

## What is already known on this topic?

Previous study show ED can impact the quality of life. ED has multiple causes. One is associated with vascular diseases and the cavernous arteries that resemble the coronary arteries. The patients with structural heart disease and medically refractory angina have a particularly high prevalence of ED.

## What this study adds?

The findings support the result of cardiac surgery has improved ED in the patient. The prevalence in ED symptoms decreased approximately 12% at one-year postoperation possibly the result of improvement in their cardiac function. The results of this study can be used to inform patients prior to surgery.


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## Potential conflicts of interest

The authors declare no conflict of interest.

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