

# Quality of life in patients after minimally invasive endoscopic atraumatic coronary artery bypass grafting: a long-term follow-up

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## Abstract

**Background:** Quality of life (QoL) is an acknowledged parameter that subjectively describes treatment effectiveness and is used also in cardiac surgery. Minimally-invasive totally endoscopic atraumatic coronary artery bypass grafting (EACAB) does not require the use of cardiopulmonary bypass, reduces hospital stay and facilitates early rehabilitation. Therefore, this procedure should significantly improve QoL in patients with coronary artery disease.

**Aim:** To assess QoL during a 12-year follow-up in patients who underwent EACAB.

**Methods:** The study group comprised 706 consecutive patients who underwent EACAB between April 1998 and December 2010. Median duration of follow-up was 1918 days. QoL was assessed by either telephone interview or letter correspondence. Complete data were obtained from 413 persons aged  $59 \pm 6$  years. We evaluated the effect of pre- and postoperative variables on QoL.

**Results:** Compared with the preoperative period, a marked improvement in QoL after EACAB was reported by 38.6%, and improvement by 37.2% of patients. No change in QoL was noted by 18.8% of subjects, and 5.4% of responders reported deterioration of QoL. The following parameters were found to have no impact on QoL: gender ( $p = 0.3$ ), myocardial infarction (MI) before EACAB ( $p = 0.3$ ), diabetes mellitus ( $p = 0.7$ ), and baseline angina severity by the Canadian Cardiovascular Society (CCS) classification ( $p = 0.8$ ). Time delay between the surgery and QoL assessment had no impact on the results. During the follow-up, reported QoL was related to the severity of angina symptoms ( $p = 0.006$ ), need for rehospitalisation ( $p = 0.02$ ), MI ( $p = 0.04$ ) and repeated revascularisation ( $p = 0.02$ ). In multivariate analysis, only MI had a significant impact on QoL ( $p = 0.04$ ). Current drug therapy had no impact on QoL.

**Conclusions:** EACAB significantly improved QoL in coronary patients. MI during follow-up was associated with deterioration of QoL.

**Key words:** quality of life, MIDCAB, EACAB

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## INTRODUCTION

Quality of life (QoL) defines how physical, mental, social, and emotional status of a human being creates satisfaction from life at all its levels [1]. Self-reported health-related quality of life (QoL) may be a measure of treatment effectiveness during long-term follow-up [2]. In a time when improved well-being is often considered a treatment goal, QoL assessment

has become a critical tool to evaluate the effectiveness of management approaches [3].

Minimally-invasive totally endoscopic atraumatic coronary artery bypass grafting (EACAB) is performed without the use of cardiopulmonary bypass [4] in patients with a critical stenosis of the left anterior descending artery as an isolated procedure or a part of hybrid therapy in patients with multi

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-vessel coronary artery disease (CAD) [5]. Advantages resulting from low invasiveness of such treatment include reduced pain, hospital stay, and duration of rehabilitation period.

As adequate and comprehensive national data are lacking, we evaluated QoL after EACAB during a 12-year follow-up, along with an attempt to identify pre- and postoperative factors that might determine QoL.

## METHODS

### Study group

We studied 706 consecutive patients with single-vessel (76.5%) or multivessel (23.5%) CAD who underwent EACAB since April 1998 to December 2010. The study was performed from February to September 2011. Mean duration of follow-up was  $2132 \pm 1313$  (median 1918.5, longest follow-up 4661) days.

### Evaluation of quality of life

QoL was assessed based on the information provided by patients by either telephone interview or letter correspondence. Patients were explained the term QoL and asked to self-evaluate their current QoL by answering question: "What is your current quality of life compared to the preoperative period?". QoL was assessed using 5-point Likert scale [6] and reported as marked deterioration (1), deterioration (2), no change (3), improvement (4), or marked improvement (5). Complete data were obtained from 413 (58.5%) patients, with no significant effect of the duration of follow-up on the response rate. The study was approved by a local ethics committee. All patients were informed about the purpose of study and asked to participate in it. In the overall cohort (706 subjects), 20 patients died during the follow-up (data verified using the national personal identification number database PESEL).

Baseline demographic and clinical characteristics of the patients were evaluated based on hospital records, including severity of angina by the Canadian Cardiovascular Society (CCS) classification [7] and the presence of concomitant diseases. All patients were interviewed regarding rehospitalisations, occurrence of major cardiac and cerebrovascular events (MACCE), and current drug therapy.

### Statistical analysis

Statistical analysis was performed using the MedCalc software (v11.0.1). Results were reported as mean values and standard deviations for quantitative variables, and as percentages for qualitative variables. Between group differences in quantitative variables were tested using analysis of variance (for normally distributed variables) or the Kruskal-Wallis test (for non-normally distributed variables). Normality of the data distribution was verified using the Shapiro-Wilk test. Chi-square test was used for qualitative variables. Multivariate analysis was performed using the multiple regression model, with QoL as the dependent variable, and independent variables

were identified in univariate analyses at  $p < 0.01$  for inclusion into the model.  $P < 0.05$  was considered statistically significant.

## RESULTS

### Patient characteristics

Detailed patient characteristics are shown in Table 1. Severity of angina in the pre- and postoperative period is shown in Table 2. The vast majority of patients received drug therapy as recommended by the European Society of Cardiology (Table 3) [8].

**Table 1.** Baseline characteristics of the subjects (n = 413)

| Variable                               | Value      |
|----------------------------------------|------------|
| Age [years]                            | $59 \pm 6$ |
| Male gender                            | 81.8%      |
| Diabetes                               | 16%        |
| Overweight/obesity                     | 76.4%      |
| History of MI                          | 39.4%      |
| History of PCI                         | 23.5%      |
| Hypertension                           | 47.7%      |
| Peripheral arterial disease            | 2%         |
| Renal failure                          | 2%         |
| Obstructive lung disease               | 3%         |
| Left ventricular ejection fraction [%] | $55 \pm 7$ |

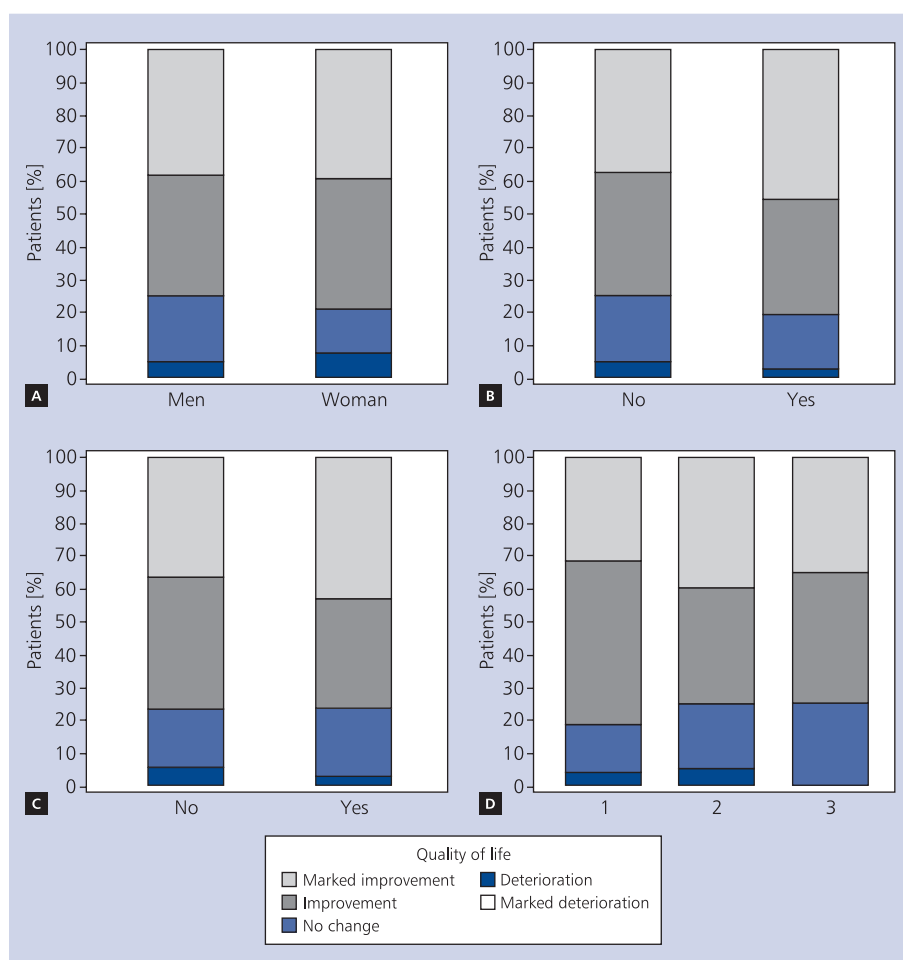
MI — myocardial infarction; PCI — percutaneous coronary intervention

**Table 2.** Severity of angina as assessed using the Canadian Cardiovascular Society (CCS) classification before the endoscopic aortic coronary artery bypass (EACAB) surgery and during the long-term follow-up

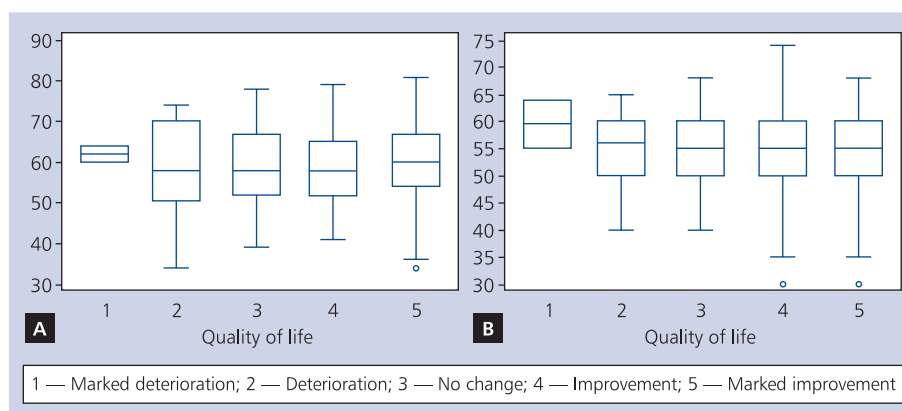
| CCS class | Before EACAB | After EACAB | P         |
|-----------|--------------|-------------|-----------|
| 0         | 0            | 59.9%       | $< 0.001$ |
| 1         | 7%           | 15.6%       |           |
| 2         | 86.7%        | 13.9%       |           |
| 3 or 4    | 6.3%         | 10.5%       |           |

**Table 3.** Drug therapy during long-term follow-up

| Drug class                      | Proportion of patients |
|---------------------------------|------------------------|
| Acetylsalicylic acid            | 88.6%                  |
| Clopidogrel/ticlopidine         | 9.9%                   |
| Beta-blocker                    | 87.1%                  |
| Statin                          | 81.6%                  |
| ACE inhibitor                   | 4.2%                   |
| Angiotensin receptor antagonist | 13.3%                  |
| Calcium antagonist              | 15.9%                  |
| Diuretic                        | 22%                    |



**Figure 1.** Impact of gender (A), diabetes mellitus (B), history of myocardial infarction (C) and angina severity (D) on quality of life

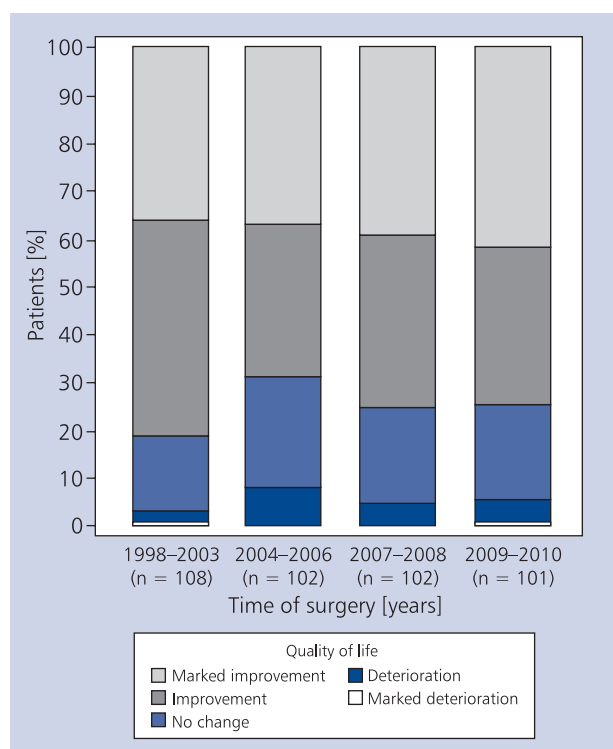


**Figure 2.** Impact of patient age (A) and ejection fraction (B) on quality of life

### Quality of life

Compared with the preoperative period, a marked improvement in QoL after EACAB was reported by 38.6% of patients, and improvement by 37.2% of patients. No change in QoL was noted by 18.8% of subjects, and 5.4% of responders reported deterioration of QoL. The following variables were found to have no impact on

QoL: gender ( $p = 0.3$ ), diabetes mellitus ( $p = 0.7$ ), history of myocardial infarction (MI) before EACAB ( $p = 0.3$ ) (Figs. 1A–C), baseline angina severity as assessed using the CCS classification ( $p = 0.8$ ) (Fig. 1D), patient age ( $p = 0.6$ ), and ejection fraction ( $p = 0.8$ ) (Figs. 2A, B). Time delay between the surgery and QoL assessment had no impact on the results ( $p = 0.6$ ) (Fig. 3).



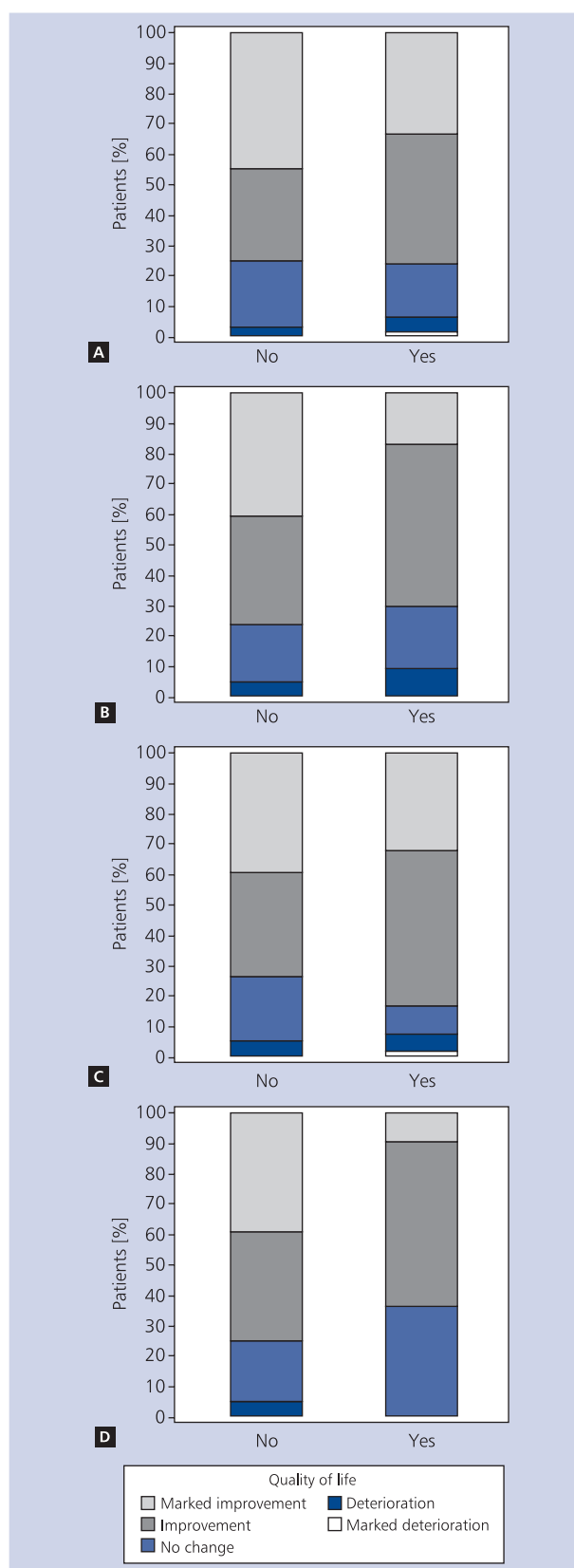
**Figure 3.** Impact of time of surgery on quality of life

During the follow-up, 52% of patients who reported QoL required rehospitalisation, 7.3% suffered MI, and 17% required percutaneous coronary intervention (PCI). Less than 2% of patients suffered stroke or transient ischaemic attack (TIA). Except for stroke, all these complications resulted in a statistically significant deterioration of QoL (Figs. 4A–D). Rehospitalised patients more frequently reported deterioration of QoL ( $p = 0.02$ ), and patients who suffered MI more frequently reported no improvement or deterioration of QoL ( $p = 0.04$ ), while patients who did not require PCI were characterised by much better QoL ( $p = 0.02$ ). Severity of angina symptoms was also significantly related to postoperative QoL (Fig. 5), and patients with more severe angina more frequently reported deterioration of QoL ( $p = 0.006$ ). No relation with QoL was found for drug therapy, including with acetylsalicylic acid ( $p = 0.33$ ), clopidogrel/ticlopidine ( $p = 0.13$ ), beta-blockers ( $p = 0.08$ ), ACE inhibitors ( $p = 0.9$ ), angiotensin receptor antagonists ( $p = 0.65$ ), calcium antagonists ( $p = 0.57$ ), diuretics ( $p = 0.51$ ), and statins ( $p = 0.9$ ).

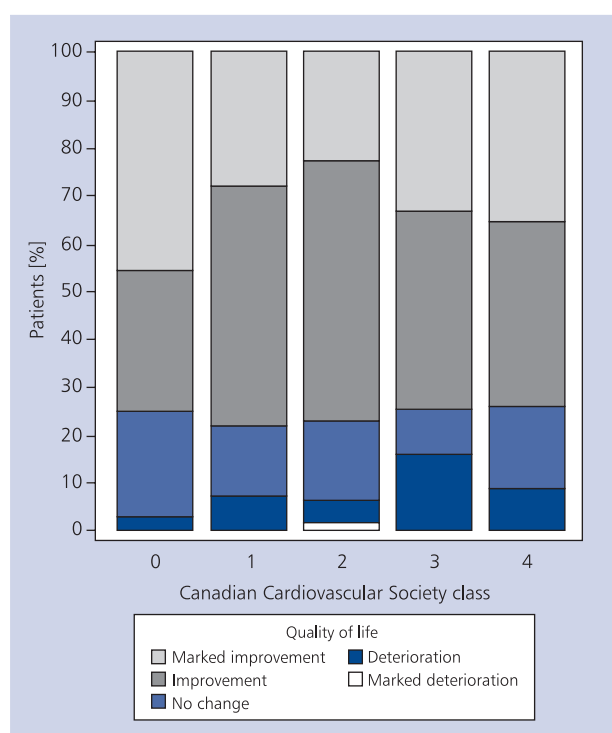
The above variables were included in multivariate analysis. In multiple regression model, only MI during long-term follow-up had a significant impact on QoL ( $p = 0.04$ ).

## DISCUSSION

In this study, we evaluated subjective QoL in patients with ischaemic heart disease who underwent EACAB. QoL,



**Figure 4.** Impact of rehospitalisation (A); myocardial infarction (B); repeated revascularisation (C) and stroke/transient ischaemic attack on quality of life



**Figure 5.** Quality of life according to the class of angina symptoms by the Canadian Society of Cardiology in a follow-up assessment

a soft endpoint in the postoperative evaluation, is currently considered a marker of therapeutic effectiveness. Our findings indicate that EACAB effectively improves self-reported QoL, with most patients (75.8%) reporting improvement of QoL, and only 5.4% of patients declaring deterioration of QoL. These results depended primarily on long-term complications, mostly severity of angina symptoms. Deterioration of QoL correlated positively with increasing angina. Rumsfeld et al. [9] evaluated QoL in cardiac surgery patients and showed a beneficial effect of revascularisation (both with PCI and with conventional coronary artery bypass grafting [CABG]) on improvement in QoL. Cohen et al. [10] showed that frequency of anginal attacks is a major factor affecting QoL. Diegeler et al. [11] compared effectiveness of minimally invasive direct coronary artery bypass grafting (MIDCAB) with CABG in regard to reduction of pain and improvement of QoL. Patients who underwent MIDCAB reported less pain, improved physical activity and better sleep quality.

Of note, our findings are consistent with other study performed in our country, in which QoL was evaluated using a simple visual scale in patients after CABG during a follow-up lasting 8.5 months on average and shown to correlate significantly with CCS grade [12]. Similar results were obtained by our group in a group of young, professionally active male patients [13]. With different methodology of QoL assessment

and bypass grafting technique, however, any attempts to extrapolate these findings to EACAB patients must be limited.

In our study, significant factors correlating with subjective QoL included MI after EACAB, need for repeated revascularisation, and rehospitalisation due to any cause. Patients who suffered MI reported significant deterioration of QoL. This is likely explained by the fact that occurrence of an acute coronary syndrome is associated with anginal symptoms that correlate with self-reported QoL. Successful repeated revascularisation that decreases or eliminates angina should lead to improvement in CCS class and QoL.

A major benefit of EACAB is reduction in MACCE [14, 15]. In addition to the evaluation of conventional postoperative complications, QoL is an important parameter of treatment effectiveness that correlates with the rate of adverse events [16]. Al-Ruzzeh et al. [17] evaluated QoL in patients after MIDCAB and controls, showing good perception of overall health status and its specific aspects in the operated patients. Minimally invasive treatment contributes to improvement in physical health, reduction of postoperative pain, shorter duration of hospital stay, and more rapid recovery, which implicates improvement in QoL [18].

Of note, MIDCAB/EACAB may be useful in the treatment of multivessel CAD under hybrid procedures. De Canniere et al. [19] compared conventional bypass grafting with hybrid approach and showed shorter stay in the postoperative ward, less blood transfusions and pain, and improved early QoL in patients after hybrid procedures.

Our findings indicate that gender, patient age, and preoperative ejection fraction had no effect on QoL improvement. These results are consistent with other national data [13, 20].

Our results should also be compared with the study by Dudek et al. [21] who evaluated the effect of depressive disorders on QoL in patients undergoing PCI and showed that successful revascularisation is associated with improvement in QoL, similarly to findings in EACAB patients. This improvement is, however, limited by coexisting depressive disorders, as QoL is also determined by perioperative anxiety and depression [22]. Conventional bypass grafting was shown to result in a significant reduction of anxiety and depression level. Overall, results of these two studies [21, 22] suggest that EACAB is also associated with an improvement in mental health status which should translate to QoL improvement. Wray et al. [23] also showed excellent QoL in most patients after EACAB, along with a reduced anxiety and depression level compared with the preoperative period.

### Limitations of the study

Our study had several major limitations. The duration of follow-up varied from several months to 12 years. As a result, QoL in patients shortly after the surgery was related to different factors (mostly pain associated with surgical intervention)

than after a few years of follow-up (mostly attributed to MACCE). In addition, QoL assessment using subjective 5-point Likert scale [6] has made it difficult to compare these results with findings in other patient groups. Although structured, the study may not be generalised, as no standardised questionnaire was used. However, such method has previously been successfully used in the literature [18]. Another limitation was the fact that the follow-up data was obtained from only 58.5% patients. Despite this, our study group is currently the largest published cohort of patients who underwent EACAB and reported on QoL. Finally, QoL was ascertained only after the surgery, and no objective baseline QoL data were available. Similar methodology was, however, used in the previously published reports [17, 23]. All these limitations call for cautious interpretation of our findings and should be taken into account when planning further studies in this clinically interesting group of EACAB patients.

## CONCLUSIONS

CAD treatment with EACAB resulted in a significant improvement in QoL during long-term follow-up, mostly by reducing angina. The most important factor limiting improvement in QoL during long-term follow-up was the occurrence of MI. Our findings call for further research using standardised tools among patients undergoing minimally invasive cardiac surgery.

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**Conflict of interest:** none declared

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# Jakość życia chorych po małoinwazyjnym endoskopowym atraumatycznym pomostowaniu wieńcowym: obserwacja odległa

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## Streszczenie

**Wstęp:** Jakość życia (QoL) jest uznanym parametrem subiektywnie określającym skuteczność leczenia, także w kardiologii. Małoinwazyjne endoskopowe pomostowanie wieńcowe z videoskopowym pobraniem tętnicy piersiowej wewnętrznej (EACAB) nie wymaga zastosowania krążenia pozaustrojowego, skraca czas pobytu w szpitalu i ułatwia wczesną rehabilitację, dlatego powinno poprawiać jakość życia osób z chorobą wieńcową.

**Cel:** Celem pracy była ocena QoL chorych poddawanych EACAB w obserwacji 12-letniej.

**Metody:** Badaniem objęto 706 kolejnych pacjentów z jedno- (76,5%) i wielonaczyniową (23,5%) chorobą wieńcową, u których wykonano EACAB w okresie 04.1998–12.2010. Mediana czasu obserwacji po operacji wynosiła 1918 dni. Jakość życia oceniano na podstawie wywiadu telefonicznego lub korespondencji listownej. Pacjentów proszono o samoocenę aktualnej QoL w porównaniu z okresem sprzed operacji. Spośród 706 chorych w ciągu 12-letniej obserwacji zmarło 20 osób. Pełne dane uzyskano od 413 (58,5%) pacjentów, w średnim wieku  $59 \pm 6$  lat, bez istotnego statystycznie wpływu czasu obserwacji na udział w badaniu. Oceniono wpływ zmiennych przed- i pooperacyjnych na QoL.

**Wyniki:** Znacznie lepszą QoL w porównaniu z tą sprzed operacji zadeklarowało 38,6% badanych, lepszą — 37,2% chorych. Brak zmiany w zakresie QoL stwierdziło 18,8% pacjentów. Na pogorszenie QoL wskazało 5,4% osób. Na uzyskane wyniki nie wpływały: płeć ( $p = 0,3$ ), występowanie cukrzycy przed operacją ( $p = 0,7$ ) i zawał serca (MI) w wywiadzie ( $p = 0,3$ ). Jakość życia nie zależała także od wyjściowego nasilenia dolegliwości dławicowych wg skali Kanadyjskiego Towarzystwa Kardiologicznego (CCS) ( $p = 0,8$ ). Spośród badanych zmiennych ciągłych na QoL nie wpływały: wiek chorych ( $p = 0,6$ ) i wartość frakcji wyrzutowej ( $p = 0,8$ ). Czas, jaki upłynął od operacji, również nie różnicował w sposób istotny charakteru udzielanych odpowiedzi. W obserwacji odległej 52% chorych wymagało powtórnej hospitalizacji (niezależnie od przyczyny), 7,3% przebyło MI, a 17% wymagało powtórnej rewaskularyzacji wieńcowej [wszyscy chorzy — przeszłokrotna interwencja wieńcowa (PCI)]. Około 2% chorych przebyło udar lub incydent przemijającego niedokrwienia mózgu w obserwacji odległej. Oprócz udaru, wszystkie powikłania znamienne statystycznie wpływały na pogorszenie QoL w obserwacji odległej. Chorzy powtórnie hospitalizowani częściej zgłaszali pogorszenie QoL ( $p = 0,02$ ). Pacjenci z MI częściej deklarowali brak poprawy lub pogorszenie QoL ( $p = 0,04$ ), natomiast chorzy niewymagający PCI w obserwacji odległej cechowali się częściej znacznie lepszą QoL ( $p = 0,02$ ). Także nasilenie dławicy wg CCS istotnie determinowało poziom pooperacyjnej QoL. Pogorszenie QoL deklarowali częściej pacjenci z większym nasileniem dolegliwości dławicowych ( $p = 0,006$ ). Jednak wyniki analizy wielu zmiennych potwierdziły istotny wpływ jedynie MI ( $p = 0,04$ ). Stosowana farmakoterapia nie korelowała z deklarowanym poziomem QoL.

**Wnioski:** EACAB znacznie poprawia QoL. Znamienny wpływ na pogorszenie QoL w obserwacji odległej ma fakt występowania MI. Uzyskane rezultaty skłaniają do kontynuowania badań wśród chorych po kardiologicznych zabiegach małoinwazyjnych za pomocą wystandaryzowanych narzędzi oceniających QoL.

**Słowa kluczowe:** jakość życia, MIDCAB, EACAB

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