Prospective Study of Quality of Life Before and After Open Heart Operations

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Background. The aim of this prospective study, with completion of questionnaires before and 3 months after open heart operations, was to evaluate the improvement of quality of life brought about by these operations and the predictors of this improvement.

Methods. The Nottingham health profile questionnaire contains 38 subjective statements divided into six sections: energy, physical mobility, emotional reaction, pain, sleep, and social isolation. Factors influencing quality of life scores were determined by analysis of covariance. Factors influencing the status of the patients (improved or worsened) were determined by logistic regression.

Results. From January to July 1994, 215 consecutive patients underwent elective open heart operations. The comparison between mean preoperative and postoperative scores showed an improvement in all sections of quality of life. An average of 80% of patients were improved by their operations. Independent predictors of less improvement of quality of life scores were as follows: for the energy section, age over 70 and New York Heart Association functional class III or IV; for sleep, age over 70; for physical mobility, New York Heart Association functional class III or IV; for social isolation, female gender; and for pain, age over 70 and abnormal segmental wall motion. Independent predictors of patients worsened by operation were as follows: New York Heart Association functional class III or IV in the energy section (odds ratio = 3.7, 95% confidence interval 1.4 to 9.8) and in the physical mobility section (odds ratio = 2.4, 95% confidence interval 1.02 to 5.5), female gender in the social isolation section (odds ratio = 2.8, 95% confidence interval 1.03 to 7.7), and presence of at least one comorbid disease in the emotional reaction section (odds ratio = 2.5, 95% confidence interval 1.17 to 5.2).

Conclusions. Cardiac operations improve quality of life in patients. The improvement is similar for patients undergoing coronary artery bypass grafting versus valve replacement, and for patients with no postoperative events versus those with nonlethal postoperative complications. The strongest predictive factors for quality of life are age and New York Heart Association functional class.

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In cardiac operations, results are usually evaluated in terms of mortality, complications, or recurrence of symptoms. These criteria restrict the field of evaluation to cardiac symptoms. However, problems in sleeping or limitation of physical mobility that appear or worsen after surgery affect the quality of life (QOL) of the patients and are not taken into account in traditional evaluations of surgical results. Most of the studies on QOL in cardiac operations deal with coronary artery bypass grafting (CABG) [1–3]. We decided to study all patients undergoing elective open heart operations during a period of 6 months in terms of QOL and the factors influencing QOL status, particularly the influence of age and the type of operation. We chose the Nottingham health profile (NHP) questionnaire [4, 5], which has been applied to several areas of treatment, particularly to compare pre- and postoperative QOL [6, 7].

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Material and Methods

From January to July 1994, 215 patients underwent elective open heart operations requiring cardiopulmonary bypass in the Department of Thoracic and Cardiovascular Surgery of Besançon (France). The questionnaire was distributed to all patients before and 3 months after open heart operations.

The variables recorded were as follows: age, sex, occupation, heart disease, angina pectoris status according to Canadian classification, dyspnea class according to the New York Heart Association (NYHA) classification, comorbid diseases (previous heart operation, chronic obstructive pulmonary disease, renal failure, diabetes mellitus, cerebral or peripheral vascular disease), ejection fraction, left ventricular wall motion, surgical procedure, and operative complications.

The NHP questionnaire was written originally in English [4], then underwent rigorous translation into French, back-translation, and linguistic validation [8]. It contains 38 subjective statements divided into six sections: energy, physical mobility, emotional reaction, pain, sleep, and social isolation. The number of statements in

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each section varies, from three in the energy section to nine in the emotional reaction section. Within each section, an aggregation of responses is made possible by the use of item weights, determined on a general population sample using the Thurstone method of paired comparisons [8]. The questionnaire is included in the Appendix and has been reported previously [8].

One question (question 39) was added to the postoperative questionnaire to obtain the patient's overall perception of improvement due to the operation, namely, "I feel better than before heart surgery."

Statistical Analysis

The answer to each question was binary (yes or no). The score of each section was obtained by adding the weights of the questions to which the responses were positive. For example, the energy section is composed of three questions (see Appendix 1), each of which has a weight (39.20 for the first question, 36.80 for the second, and 24.00 for the third). A patient who answered no to the first question, and yes to the second and third, would have a score of $[(0 \times 39.20) + (1 \times 36.80) + (1 \times 24.00)] = 60.80$ for the energy section. Thus, scores range from 0 to 100; a higher score indicates a higher level of dysfunction or distress.

FACTORS INFLUENCING QUALITY OF LIFE SCORES. For the preoperative period, we evaluated the influence of each variable on each section of QOL using a Wilcoxon rank sum test. The preoperative and postoperative scores for each section of QOL were compared using a Wilcoxon matched-pairs rank test.

To determine the preoperative factors influencing the improvement of QOL scores, we analyzed each variable category in each section using analysis of covariance, with the changes in QOL measures as dependent variables. To determine independent predictors, factors with a level of significance less than or equal to 0.20 in univariate analysis were analyzed simultaneously by analysis of covariance, with the changes in QOL measures as dependent variables.

FACTORS INFLUENCING THE PROPORTION OF PATIENTS IMPROVED OR WORSENED BY OPERATION. For each section of QOL, the preoperative and postoperative scores of each patient were compared to determine which patients improved and which patients worsened after operation. To determine the factors influencing the status of a patient, with the dependent variable being binary (improved or worsened), we performed logistic regression, first by univariate analysis and then by multivariate analysis. Variables with a level of significance less than or equal to 0.20 in the univariate analysis were included in the multivariate model, which was analyzed using a stepwise logistic regression. Occupational status was omitted from these analyses because the large number of categories made interpretation difficult.

All statistical analyses were performed with BMDP statistical software (BMDP, Los Angeles, CA).

Results

Characteristics of the Study Population

Six patients did not fill in the questionnaire. Four did not speak French and 2 refused, resulting in 209 completed preoperative questionnaires.

The mean age was 65 ± 10 years, and the sex ratio (male to female) was 3:1 (Table 1). Eighty-one patients (39%) were less than 65 years of age, 39 (18%) were aged 65 to 70, 59 (29%) were 70 to 75, and 30 (14%) were older than 75.

The occupations or former occupations of the patients were classified in seven sections according to the official record classification of INSEE (Institut National de la Statistique et des Etudes Economiques), the French Institute of Statistics and Economic Studies. Nurses, schoolteachers, civil servants, clergymen, technicians, and foremen were classified as helping professions. More than half of the patients were white-collar or blue-collar workers. Twenty-five patients (most of them women) had never been employed.

Half of the patients suffered from coronary artery disease and 40% from heart valve disease. The predominant heart valve disease was calcified aortic stenosis (62 patients, 30%); 17 patients (8%) had a double-valve disease. The postoperative course was uneventful in 184 patients. Eight patients (3.7%) died postoperatively.

Factors Influencing Preoperative Quality of Life

Characteristics significantly associated with preoperative QOL are reported in Table 2. Compared with those undergoing an initial procedure, patients with previous cardiac operations had a significantly higher energy score ($p < 0.01$). The physical mobility score was higher in women ($p < 0.01$) and in patients suffering from cerebral or peripheral vascular disease ($p < 0.05$). The emotional reaction score was higher in women ($p < 0.05$), in patients with an ejection fraction less than 0.30 ($p < 0.01$), and in patients with NYHA functional class III or IV ($p < 0.05$).

Improvement of Quality of Life Brought About by Operation, and Factors Influencing This Improvement

Eight patients died within 1 month and 2 within 3 months after discharge from the hospital; 199 postoperative questionnaires were completed. Ninety-one percent of the patients answered yes to question 39 regarding improvement.

The comparison between preoperative and postoperative scores showed an improvement in all sections of QOL (Fig 1). Independent predictors of less improvement of QOL scores were as follows: age over 70 and NYHA functional class III or IV for the energy section, age over 70 for the sleep section, NYHA functional class III or IV for the physical mobility section, female gender for the social isolation section, and age over 70 and abnormal segmental wall motion for the pain section (Table 3). Type of operation (CABG versus heart valve operation) (Fig 2) and nonlethal complications did not influence the improvement in QOL.

In an average of 80% of patients, QOL was improved by operation (Table 4). The distribution of patients improved or worsened by operation was not different by

Table 1. Characteristics of the Study Population

Variable	No. of Patients	Percentage
Sex		
Male	156	75
Female	53	25
Age (y)		
≤70	120	57
>70	89	43
Occupational category		
Managers	10	5
Small business owners	32	15
Helping professions	21	10
Farmers	11	5
White collar workers	56	27
Blue collar workers	54	26
Nonworkers	25	12
Heart disease		
Coronary artery disease	110	53
Heart valve disease	84	40
Coronary artery disease and heart valve disease	15	7
Preoperative status		
Angina		
No angina	78	37
I–II	100	48
III–IV	31	15
NYHA functional class		
I–II	176	84
III–IV	33	16
Ejection fraction		
≥0.50	162	78
0.30–0.50	36	17
<0.30	11	5
Segmental wall motion		
Normal	157	75
Abnormal	52	25
Comorbid diseases		
None	159	76
Diabetes mellitus	25	12
Cerebral or peripheral vascular disease	21	10
Renal failure	2	1
Chronic obstructive pulmonary disease	2	1
Prior heart operation	11	5
Postoperative events		
No events	184	88
Deaths	8	3.7
Low cardiac output	4	2
Reoperation for bleeding	3	1.5
Pericardial effusion	4	2
Mechanical ventilation >24 h	5	2
Sternal wound infection	1	0.5

NYHA = New York Heart Association.

age or type of procedure. In multivariate analysis, independent predictors of patients worsened by operation were as follows: NYHA functional class III or IV in the energy section (odds ratio = 3.7, 95% confidence interval 1.4 to 9.8) and in the physical mobility section (odds ratio = 2.4, 95% confidence interval 1.02 to 5.5), female gender in the social isolation section (odds ratio = 2.8, 95% confidence interval 1.03 to 7.7), and presence of at least one comorbid disease in the emotional reaction section (odds ratio = 2.5, 95% confidence interval 1.17 to 5.2).

Table 2. Factors Influencing Preoperative Quality of Life[a]

Variable	Score	*p* Value
Energy		
Previous heart operation		
No	37 ± 34	<0.01
Yes	70 ± 34	
Physical mobility		
Sex		
Male	17 ± 17	<0.01
Female	27 ± 20	
CPVD		
No	18 ± 18	<0.05
Yes	28 ± 23	
Emotional reaction		
Sex		
Male	19 ± 20	<0.05
Female	26 ± 25	
Ejection fraction		
>0.30	19 ± 20	<0.01
<0.30	40 ± 31	
NYHA functional class		
I–II	19 ± 20	<0.05
III–IV	28 ± 28	

[a] Data are mean ± standard deviation.

CPVD = cerebral or peripheral vascular disease; NYHA = New York Heart Association.

Comment

Results of cardiac operations are usually assessed with mortality and morbidity rates. The study of QOL is a

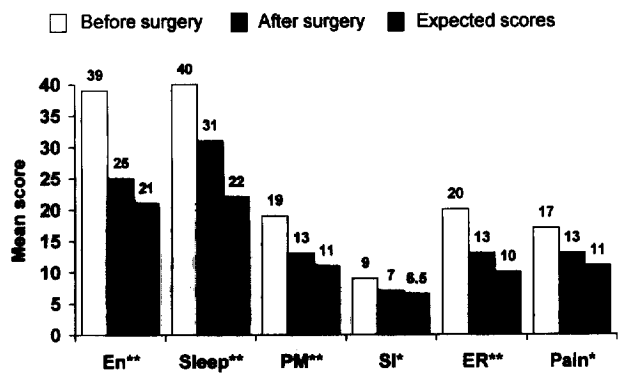

*Fig 1. Mean scores for each section of quality of life before and after operation (199 patients). The Wilcoxon matched-pairs rank test, comparing scores before and after operation for each section of quality of life, showed an improvement in all sections (**p < 0.01; *p < 0.05). Expected scores are based on reference scores for a "normal" population [10], applied to sex and age distribution in our series. Postoperative scores are similar to expected scores in all sections except the sleep section. (En = energy; ER = emotional reaction; PM = physical mobility; SI = social isolation.)*

Table 3. Independent Predictors of Less Improvement of Quality of Life Scores

Section	Variable Selected From Univariate Analysis ($p < 0.20$)	p Value (Univariate)	Negative Factor	p Value (Multivariate)
Energy	Age	0.06	>70	0.04[a]
	NYHA class	0.008	III–IV	0.01[a]
	Comorbid disease	0.12	Presence	0.06
Sleep	Age	0.12	>70	0.02[a]
	NYHA class	0.04	III–IV	0.06
Physical mobility	NYHA class	0.003	III–IV	0.006[a]
	Ejection fraction	0.14	<0.30	0.42
	Postoperative events	0.13	Presence	0.15
Social isolation	Sex	0.006	Female	0.01[a]
	NYHA class	0.18	III–IV	0.14
Emotional reaction	Comorbid disease	0.07	Presence	0.19
	Ejection fraction	0.09	<0.30	0.15
	Postoperative events	0.07	Presence	0.16
Pain	Age	0.10	>70	0.02[a]
	Wall motion	0.12	Abnormal	0.01[a]
	NYHA class	0.09	III–IV	0.06
	Comorbid disease	0.01	Presence	0.16
	Postoperative events	0.09	Presence	0.38

[a] Statistically significant in multivariate analysis.

NYHA class = New York Heart Association functional class.

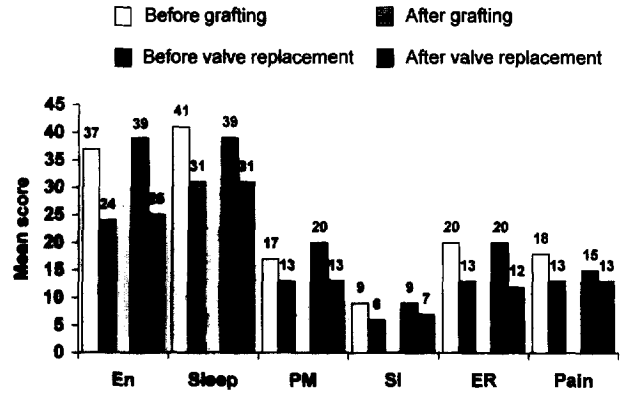

Fig 2. Mean scores of the Nottingham Health Profile scale in patients before and after grafting and heart valve replacement. Preoperative scores and postoperative scores were similar in the two groups. In each group, preoperative scores were significantly higher than postoperative scores. (En = *energy;* ER = *emotional reaction;* PM = *physical mobility;* SI = *social isolation.*)

complementary approach to the usual evaluations of surgical results.

During the postoperative visit at month 3, patients often complain of noncardiac problems such as pain in the wound, arthritis, and others, which have been caused or worsened by operation. Even though a surgical intervention is successful, it may not improve the quality of life. For example, some troubles that patients perceived to be of minor importance before operation when compared with cardiac symptoms, or that they kept hidden because of fear of operation, may be of major importance after the operation. All of these disturbances, which can be found in a QOL evaluation, are omitted in traditional assessments of surgical outcome.

The NHP questionnaire is a generic scale and was not originally designed for patients undergoing cardiac operations. Thus, it is an adjunct to traditional clinical measures. It is not intended to be a measure of disease, but an indicator of limitations on health [7]. The NHP questionnaire explores different aspects of QOL, and the pre- and postoperative states can be easily compared. The questions are simple and the questionnaire is easy to complete. It has been used successfully in a number of treatment evaluations, including cardiac transplantation [6], heart-lung transplantation [7], cardiovascular strokes [9], and CABG [1–3]. Its translation, which has been certified as correct in several languages, allows comparisons between different cultures and populations.

The preoperative QOL scores were similar in patients older and younger than 70 years of age. This fact probably represents a selection in old patients to undergo cardiac operations. Scores for improvement of energy, sleep, and pain were lower for patients older than 70 than for those younger than 70, but the proportion of patients improved or worsened was not statistically different between the groups. This suggests that even if improved, older patients are more sensitive to side effects induced by operation. Improvement of QOL in all the sections of the NHP questionnaire confirmed the results of Caine and associates [2], which were restricted to male patients younger than 60 undergoing CABG. Our study extended these results to heart valve operations; the QOL improved similarly after CABG and heart valve operations.

Postoperative scores were similar to expected scores in all sections except the sleep section (see Fig 1). This tends

Table 4. Percentages of Patients Improved by Operation[a]

Section	Overall	≤70 y	>70 y	CABG	HVO
Energy	88	92	82	89	87
Sleep	71	74	67	69	73
Physical mobility	77	78	77	80	74
Social isolation	90	89	92	92	89
Emotional reaction	80	77	83	77	82
Pain	76	73	78	79	72

[a] There is no statistical difference in the distribution of patients improved or worsened after operation by age (less than *vs* older than 70 years) or by heart disease (coronary artery bypass grafting [CABG] *vs* heart valve operation [HVO]).

to demonstrate that, with the exception of sleep, limitations on health are the same in patients after operation as in a "normal" population. The NYHA functional class is an important independent predictor of variations in QOL. It influences not only the level of improvement of energy and physical mobility scores, but also the proportion of patients improved in these two sections. Although the NHP is a generic scale, it is sensitive to this cardiac symptom.

Another important issue concerns postoperative complications, which, one can assume, would influence QOL 3 months after their occurrence. In fact, postoperative complications did not influence improvement of QOL. This might be because of the quality of rehabilitation in convalescent homes, the stay in which was longer for patients with postoperative complications.

One possible restriction should be mentioned concerning the interpretation of our results. Improvement may reflect either the effects of operation or the effects of factors linked to operation. Our patients undergo a rehabilitation program that lasts 3 to 6 weeks. During rehabilitation, patients take exercise, follow a healthful diet, and refrain from smoking. Conversely, their medications are generally reduced. We cannot confirm what part of the improvement is due to rehabilitation and what part to the surgical procedure. Another limitation concerns the patients' knowledge of their participation in a trial. This might lead to a bias in the results if patients exaggerated their assessment of improvement to please their doctors. However, as Caine and associates [2] stated, the improvements in the scores on the NHP were so overwhelming that the underlying improvements are probably real.

Even if statistically significant, score changes were marginal in the social isolation section (with an improvement of 2%) and in the pain section (with an improvement of 4%). It is clear that the better the baseline level (9 for social isolation, 17 for pain), the less the expected improvement.

Ninety-one percent of the patients felt that their lives had been improved by operation (answered yes to question 39), whereas analysis of the NHP questionnaire showed an improvement in only 80% of patients ($p < 0.05$). Although the NHP questionnaire explores a number of aspects of QOL, there is no method for combining the different sections to obtain an overall score; nor are all aspects of QOL included in this questionnaire.

We conclude that cardiac operations improve QOL in patients. This improvement is similar for patients undergoing CABG versus valve replacement, and for patients with no postoperative events versus those having nonlethal postoperative complications. The strongest predictors of improvement of QOL were age and preoperative NYHA functional class.

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Appendix 1. Nottingham Health Profile Questionnaire Classified According to Sections [8]

Physical mobility
- I'm unable to walk at all.
- I can only walk about indoors.
- I need help to walk about outside.
- I find it hard to dress myself.
- I find it hard to stand for long.
- I have trouble getting up and down stairs or steps.
- I find it hard to bend.
- I find it hard to reach for things.

Social isolation
- I feel I am a burden to people.
- I feel lonely.
- I feel there is nobody I am close to.
- I'm finding it hard to make contact with people.
- I'm finding it hard to get on with people.

Emotional reactions
- I feel that life is not worth living.
- I've forgotten what it's like to enjoy myself.
- I feel as if I'm losing control.
- Things are getting me down.
- I wake up feeling depressed.
- Worry is keeping me awake at night.
- The days seem to drag.
- I'm feeling on edge.
- I lose my temper easily these days.

Pain
- I'm in constant pain.
- I have unbearable pain.
- I have pain at night.
- I'm in pain when I walk.
- I'm in pain when going up/down stairs or steps.
- I'm in pain when I'm standing.
- I find it painful to change position.
- I'm in pain when I'm sitting.

Sleep
- I take tablets to help me sleep.
- I lie awake most of the night.
- I sleep badly at night.
- It takes me a long time to get to sleep.
- I'm waking up in the early hours of the morning.

Energy
- I'm tired all the time.
- Everything is an effort.
- I soon run out of energy.