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Original Scientific Paper

The role of sex in health-related quality of life after cardiac surgery: a prospective study

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Background **To assess health-related quality of life (HRQOL) in patients after cardiac surgery with emphasis on sex differences.**

Design and methods **Between September 2004 and September 2005, 534 patients (413 males and 121 females) were consecutively included. HRQOL was measured by the short-form 36 (SF-36) before surgery with follow-up 6 and 12 months after surgery.**

Results **Five hundred and twenty-one patients were alive after 12 months, 462 (89%) and 465 (89.4%) responded after 6 and 12 months, respectively. Female patients had less favorable scores than male patients on most subscales of the SF-36 both before and after surgery. Both male and female patients improved substantially after surgery, but female patients reported significantly less improvement on two of eight subscales of the SF-36; role emotional and bodily pain.**

Conclusion **The study demonstrates that there are sex differences concerning HRQOL both before and after cardiac surgery. A clear overall improvement in HRQOL over the first year after cardiac surgery, more specifically during the first 6 months for both sexes was found.** ***Eur J Cardiovasc Prev Rehabil*** **15:448–452 © 2008 The European Society of Cardiology**

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Introduction

The outcome of cardiac surgery has traditionally been evaluated in terms of mortality and morbidity and poorer outcome has been found for women [1]. Women undergoing cardiac surgery are older, have more comorbidities and are more functionally impaired than men before surgery [2]. It has been argued that sex differences regarding outcome tend to reflect differences that exist preoperatively rather than differences related to cardiac surgery recovery itself [3]. In addition, a slower rate of physical recovery has been shown in female patients [4,5].

Health-related quality of life (HRQOL) has become an important endpoint following cardiac surgery [6–8]. HRQOL outcomes show how patients perceive symptoms, well-being, physical and mental functioning [4]. The literature is not consistent regarding sex differences in HRQOL outcomes after cardiac surgery [9]. Some studies have shown less improvement in physical functioning and activity for women than men [3,8–10], more anxiety [11], depression [10] and cognitive difficulties [3]. In contrast, Hunt *et al.* [12] did not find sex differences in HRQOL in patients 1 year after coronary artery bypass graft (CABG), while Mitchell *et al.* [13] found that women had more depressive symptoms before CABG, but improved to the same level as men after CABG. These conflicting results may partly be due to methodological differences. First, most studies have been retrospective in nature and few prospective studies regarding sex differences in HRQOL exist [10,14]. Second, the number of female patients included in the studies has been small. Third, most of the studies have focused on isolated CABG surgery and hence there is

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a lack of studies including patients undergoing heart valve surgery [14]. Finally, a majority of the studies have focused on short-term recovery [2,5,10,14] during the first 3 months after surgery.

The aim of this study was to assess HRQOL in patients before, 6 and 12 months after cardiac surgery with emphasis on sex differences.

Methods

The data were obtained from a prospective study designed to explore chronic pain and HRQOL before, 6 and 12 months after cardiac surgery. The Regional Committee for Medical Research Ethics approved the study. Written informed consent was obtained from each patient at baseline.

Patients

All patients undergoing cardiac surgery at the Department of Cardiothoracic Surgery, St Olavs Hospital, Norway, between September 2004 and September 2005 were assessed consecutively for inclusion in the study. Of the 631 patients undergoing cardiac surgery, 534 were included at baseline (84.6%) (Fig. 1). Data were prospectively collected. The baseline questionnaires were given to the patients for self-administration after being admitted to our clinic. Patients unable to complete the questionnaires were offered assistance.

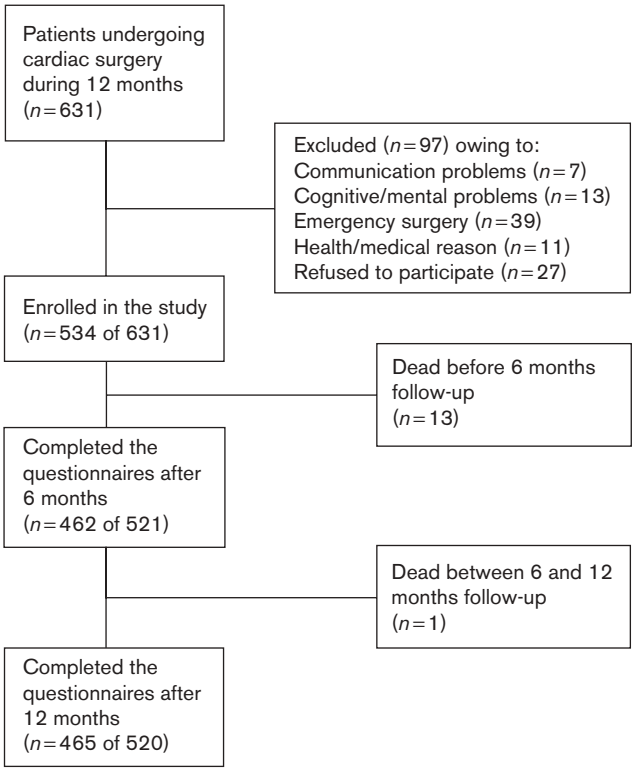
Six and 12 months after surgery the patients were sent the questionnaires by post. Nonresponders were sent one postal reminder after 3 weeks.

Measures

Data were collected using the Norwegian version of the Short-Form Health Survey (SF-36) version 1.2 [15]. Study-specific questionnaires concerning sociodemographic and medical variables were constructed, including questions on sleeping habits. Demographic and medical information was collected from an institutional database. EuroSCORE was calculated according to the standard additive method [16].

The SF-36 is a generic measure developed to assess HRQOL. It consists of 35 items measuring eight conceptual domains of health: self-reported general health (GH), physical function (PF), bodily pain (BP), mental health (MH), role limitations owing to physical problems (RP), role limitations owing to emotional problems (RE), vitality (VT) and social functioning (SF). An additional item reports health transition (HT) over the past year. The scores in each domain are transformed into 0–100 scales. For all scales higher scores reflect better health [17].

Fig. 1



Flow of patients through the study, with number of patients included and reasons for exclusion.

The SF-36 has shown satisfactory reliability and validity and is a measure that has been extensively tested as to psychometric properties in several countries, including Norway [15]. The SF-36 has been tested and found suitable for evaluating HRQOL in cardiac surgery [6].

Statistical analysis

Descriptive data are given as means (SD) and medians (ranges), respectively. Baseline patient data were compared using the Mann–Whitney *U*-test or the Student's *t*-test for continuous variables. Fisher's exact test or exact linear-by-linear association test was used for categorical variables when appropriate.

Differences in HRQOL between male and female patients were analyzed using Student's *t*-tests on each of the three assessment points. Repeated measures analysis of variance (ANOVA) were used to determine the evolution of HRQOL over the three time points of measurement. Greenhouse–Geisser correction of the degrees of freedom was used as Mauchly's test of sphericity was significant ($P < 0.05$). Only patients responding at all three measurement points were included in these analyses (casewise deletion). In comparisons within a specific assessment point, data from all patients were used.

If at least half of the items in the same scale in SF-36 were answered, the mean scores replaced missing data in the questionnaire, as recommended in the SF-36 scoring algorithm [17].

Statistical calculations were performed using SPSS for Windows version 13.0 (SPSS Inc., Chicago, Illinois, USA). Two-sided P values of less than 0.05 were considered statistical significant. Owing to multiple testing P values between 0.01 and 0.05 were interpreted with caution.

Results

Of the 534 patients included at baseline, 462 (88.7%) responded at 6 months and 465 (89.4%) patients responded after 12 months (Fig. 1). The 12 months mortality was 2.6%. Nine of 413 male patients (2.2%) and five of 121 female patients (4.1%) died (Fisher's exact test, $P = 0.33$).

Female patients were older, less educated, more likely to live without a partner, had more frequently sleeping problems and were less likely to be smokers than men. Women had higher preoperative EuroSCORE, partly related to age and sex, and underwent heart valve surgery more often than male patients.

At the time of surgery, responders differed significantly from patients not included. Patients not included were more often females, had higher EuroSCORE, belonged to The New York Heart Association class IV and were more likely to undergo miscellaneous surgery (like surgery on aorta).

Female patients reported sleeping problems more frequently than male patients at all assessment points (linear-by-linear test, $P < 0.0001$).

Table 1 displays unadjusted SF-36 scores by sex at baseline, 6 and 12 months after cardiac surgery. Women had less favorable scale scores both before and after surgery. At baseline, PF, SF, RP, MH and VT were significantly lower in female patients. At 6 months GH, PF, SF, RP, RE, MH, VT and BP were significantly lower, whereas GH, PF, RP, RE, MH, VT and BP were significantly lower after 12 months.

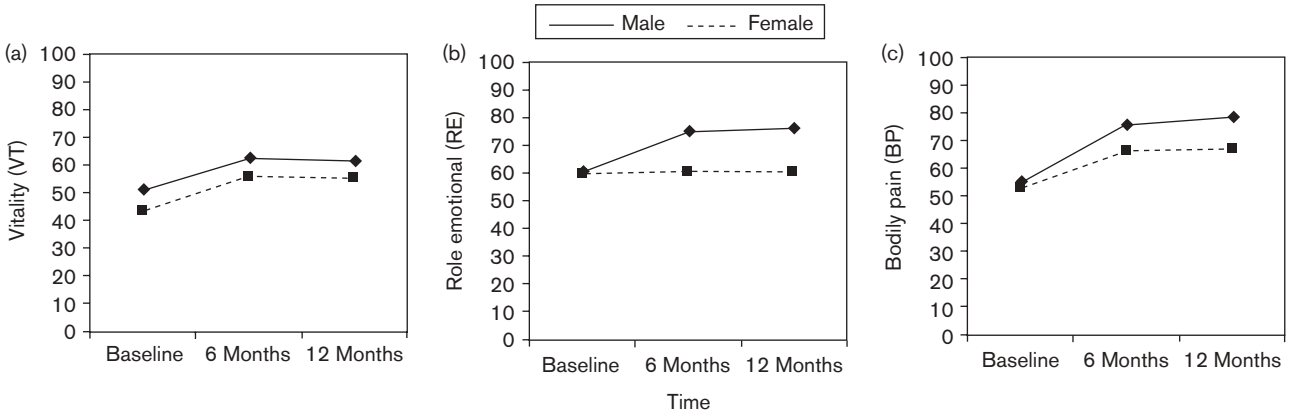
Repeated measures ANOVA (Table 1) revealed that both female and male patients improved substantially after surgery. Male and female patients had the same pattern of recovery on most SF-36 scales; a distinct increase between baseline and 6 months, stabilizing between 6 and 12 months. The scores on the HT item were similar for both sexes. The typical slope of recovery is illustrated by the vitality scale in Fig. 2a. However, there were significant differences in the development between the sexes concerning two dimensions: female patients

Table 1 Health-related quality of life before, 6 and 12 months after cardiac surgery by sex (unadjusted)

	Baseline (n=493–528)[a]		Six months (n=419–456)[a]		Twelve months (n=426–458)[a]		All three measurements (n=348–420)[a,c]
SF-36 scores	Mean (SD)	P [b]	Mean (SD)	P [b]	Mean (SD)	P [b]	P [c]
General health (GH)							
Male	64.9 (19.7)	0.490	72.0 (22.1)	0.011	71.9 (21.6)	0.004	0.179
Female	63.3 (20.7)		65.2 (21.9)		64.7 (20.9)		
Physical functioning (PF)							
Male	60.2 (26.0)	0.000	80.3 (22.2)	0.000	80.3 (22.2)	0.000	0.812
Female	43.9 (26.3)		66.8 (26.8)		65.1 (26.7)		
Social functioning (SF)							
Male	73.2 (24.8)	0.042	84.7 (22.6)	0.013	86.3 (20.5)	0.067	0.224
Female	67.7 (25.4)		77.3 (25.8)		81.4 (24.1)		
Role physical (RP)							
Male	23.4 (36.7)	0.002	58.3 (42.8)	0.010	58.1 (42.8)	0.000	0.083
Female	13.2 (27.6)		44.4 (44.1)		40.0 (42.4)		
Role emotional (RE)							
Male	58.7 (42.6)	0.054	74.6 (37.0)	0.006	75.6 (36.7)	0.001	0.025
Female	49.1 (45.9)		59.8 (44.1)		58.0 (43.1)		
Mental health (MH)							
Male	77.5 (17.0)	0.000	82.0 (16.5)	0.032	82.3 (15.4)	0.001	0.275
Female	68.9 (18.6)		77.9 (15.7)		75.6 (16.5)		
Vitality (VT)							
Male	50.7 (22.9)	0.001	62.4 (22.1)	0.010	61.5 (22.2)	0.004	0.797
Female	42.5 (22.0)		55.4 (22.5)		54.1 (21.2)		
Bodily pain (BP)							
Male	56.5 (27.2)	0.137	75.7 (25.7)	0.004	78.7 (25.2)	0.002	0.046
Female	52.3 (26.4)		66.4 (27.1)		68.9 (26.9)		
Health transition (HT)							
Male	32.0 (24.4)	0.195	82.0 (24.6)	0.791	86.8 (20.6)	0.566	0.493
Female	28.7 (24.5)		82.8 (26.0)		85.3 (22.6)		

[a]The number of cases varies owing to differences in the number of missing at each dimension of the short-form 36 (SF-36). [b]Two-sample t-test not assuming equal variances. [c]Repeated measures analysis of variance including all three time points. P value for time–sex interaction, that is, does the sex difference change during time. Adjusting for age and marital status did not change the impact of sex – hence only unadjusted results (P values) are reported.

Fig. 2



(a) Vitality scale scores (mean) of the SF-36. Higher scores indicating better health. Repeated measures ANOVA of male vs. female patients ($P=0.80$). (b) Role emotional scores (mean) of the SF-36. Higher scores indicating better health. Repeated measures ANOVA of the male vs. female patients ($P=0.025$). (c) Bodily pain scores (mean) of the SF-36. Higher scores indicating better health. Repeated measures ANOVA of the male vs. female patients ($P=0.046$). ANOVA, analysis of variance; SF-36, short-form 36.

reported less improvement than male patients on the role emotional, $F(2,692) = 3.91$, $P = 0.025$ (Fig. 2b) and on the BP dimension, $F(2,798) = 3.28$, $P = 0.046$ (Fig. 2c). The results of the repeated measures ANOVA did not change when adjusting for age and marital status. The repeated measurement ANOVA revealed that on the RE dimension, the baseline score was higher for female patients responding at all three time points of measurements (58.1), than when analyzing baseline as a single assessment point (49.1).

Discussion

Our study demonstrated that there are sex differences concerning HRQOL both before, 6 and 12 months after cardiac surgery. On six of eight dimensions of the SF-36 and the HT item, the benefit of surgery, however, was similar for both sexes. Only on BP and RE female patients did not report similar improvement as male patients. This is in contrast to two earlier studies reporting sex differences in HRQOL, as measured by SF-36, after cardiac surgery in general, including both CABG and heart valve surgery [6,18]. Falcoz *et al.* [6] reported that the improvement 2 years after cardiac surgery was equivalent in both sexes. Yun *et al.* [18] concluded that women (>65 years) had poorer HRQOL on all SF-36 scales, except the RE scale, up to 24 months after surgery. In contrast, our study revealed that female patients had significantly less improvement on the BP and RE scales 1 year after surgery.

Lindquist *et al.* [7] found no sex differences in the pattern of recovery in any HRQOL domain 1 year after CABG, whereas another study reported that female patients had an equal or greater improvement in HRQOL than male patients 2 years after CABG, using the Nottingham Health Profile (NHP) [19]. As Lindquist *et al.* [7], we also found that the outcomes in most patients, both females and males, after 6 months generally are comparable with those reported 1 year after surgery. Hence, our study does not support earlier studies of patients after CABG, which concluded that female patients have a slower recovery than male patients [5]. Follow-up was, however, longer in our study compared with most others.

In general, women consistently report worse HRQOL [5]. Women return quickly to their domestic responsibility as caregivers, and fewer have spouses to care for them [20], which may adversely affect their own recovery from the surgery. Female responders were more likely to live alone, but controlling for marital status in the repeated measurement model did not have a significant impact on the results.

Female patients had the same pain scores as males at baseline, but reported lower scores both 6 and 12 months after surgery (Fig. 2c). In most studies of chronic pain in general populations, more women than men report chronic pain [21]. The focus on cardiac-related symptoms and hence less attention to noncardiac symptoms may explain the similar pain scores for both sexes before surgery. Six and 12 months after successful surgery the patients are back in their everyday life where pain is more pronounced in females [21]. Sex differences in pain after cardiac surgery has not been studied extensively, but in an earlier study on HRQOL after CABG we did not

find differences in BP between female patients and the general female population [8].

Studies of sleeping habits have revealed that women have more problems than men [22]. SF-36 can be criticized for not including sleep as an item, in contrast to questionnaires like the NHP. Owing to this weakness of the SF-36 and the sex differences in prevalence rates of sleeping problems [22], we included single items concerning sleep. Our study revealed a higher frequency of sleeping problems among female patients both before and after surgery. In contrast, Sjöland *et al.* [19] reported that female patients had a more pronounced benefit of CABG with respect to sleep measured by the NHP. Another study reported that poor sleep quality is associated with poor HRQOL but did not report sex differences [12]. The relationship of sleep, HRQOL and sex differences after cardiac surgery should be further explored.

The major strengths of the study are the prospective design and the consecutive inclusion of patients. The sample size of female patients was higher than in many other published studies. The study covered all patients in a geographically well-defined area giving a population-based study. The study had high response rates at all three times of measurement and included 85% of all patients operated on during the study period; this is higher than most other studies on sex differences [6].

We compared the scores of repeated measurements with single assessments. The analysis revealed that on one dimension, RE, the baseline scores was higher for those responding at all measurements. This may illustrate the 'healthy responder effect'. On the other dimensions, however, the scores were similar in patients responding at all measurements and patients responding only once or twice. The healthy responder effect describes the situation where only relatively healthy participants are likely to remain in a cohort in a study with repeated measurements and long follow-up [23].

Methodological differences in studies of sex differences are a challenge. Female patients had lower scores at all assessments, but had almost the same benefit of cardiac surgery as male patients. This illustrates the importance of studying sex differences prospectively, and cross-sectional studies on this subject should be avoided. This is also supported by the results of Falcoz *et al.* [6].

In conclusion, our data demonstrated a clear overall improvement in HRQOL over the first year after cardiac surgery, more specifically during the first 6 months after surgery. When discussing sex differences it is important to note that female patients showed almost the same recovery pattern as male patients.

Acknowledgement

Conflict of interest: none.

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