Longevity and admission to nursing home according to age after isolated coronary artery bypass surgery: a nationwide cohort study

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Abstract

OBJECTIVES: Data on nursing home admission in patient’s ≥80 years after isolated coronary artery bypass grafting (CABG) are scarce. The purpose of this study was to evaluate longevity and subsequent admission to a nursing home stratified by age in a nationwide CABG cohort.

METHODS: All patients who underwent isolated CABG from 1996 to 2012 in Denmark were identified through nationwide registers. The cumulative incidence of admission to a nursing home after CABG was estimated. A Cox regression model was constructed to identify predictors for living in a nursing home 1 year after CABG. Kaplan-Meier estimates were used for survival analysis. Subanalysis on home care usage was performed in the period 2008–2012.

RESULTS: A total of 38,487 patients were included. The median age was 65.4 ± 9.5 years (1455 > 80 years) and 80% were males. The 30-day mortality rate was 2.8%, increasing with age (1.2% in patients <60 years and 7.8% in patients ≥80 years). The mortality rate at 1 year was 2.2% among patients aged <60 and 14.1% among patients ≥80 years. At the 1-year follow-up, 4.2% of patients <60 years, 7.9% of patients 60–70 years, 14.4% of patients 70–74 years, 18.5% of patients 75–79 years and 29.1% of patients ≥80 years had received home care. The proportion of patients admitted to a nursing home at 1, 5 and 10 years after CABG was 0.1, 0.4 and 1.0% (<60 years), and 1.4, 7.5 and 16.8% (≥80 years), respectively. Main predictors for living in a nursing home 1 year postoperatively were: age ≥80 years [hazard ratio (HR) 17.8, 95% confidence interval (CI) 7.4–42.8], female sex (HR 1.7, 95% CI 1.1–2.6), previous heart failure (HR 1.6, 95% CI 1.0–2.4), previous myocardial infarction (HR 2.0, 95% CI 1.3–3.2) and previous stroke (HR 3.3, 95% CI 2.1–4.9). Neither urgent nor emergency surgeries were significant predictors for living in a nursing home 1 year postoperatively.

CONCLUSIONS: The majority of all patients selected for CABG surgery in Denmark between 1996–2012, including the elderly, were able to live independently at home without the need of home care for many years after CABG. The risk of nursing home admission was small and dependent on the patient’s age, sex and preoperative comorbidities.

Keywords: Coronary artery bypass grafting • Octogenarians • Mortality • Survival • Nursing home • Home care

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INTRODUCTION

Background

Demand for coronary artery bypass grafting (CABG) in elderly patients is increasing. In Denmark, the proportion of patients ≥75 years of age undergoing isolated CABG has increased from 11 to 21% since 1996 [1]. People ≥80 years of age are the fastest growing part of the Danish population and they now account for 4% of the population, estimated to increase to 6% in 2020 [2]. A number of recent studies have shown that these elderly patients can be operated on with acceptable short- and long-term survival, with a 30-day mortality rate ranging between 4 and 10% [1, 3–5]. Postoperative mortality and long-term survival are important indicators of operative outcome but prolonged survival with highly dependent or impaired function is not a favourable outcome. Some studies indicate that a considerable proportion of patients ≥80 years of age are discharged directly to a nursing home or are living in a nursing home shortly after surgery [6–9]. Most of these studies have a limited number of patients included, they have a short follow-up time, and information about duration of the stay (permanent/temporary) in a nursing home and care facilities are missing. Knowledge about living arrangements of patients ≥80 years of age after isolated bypass surgery is scarce. There is a need for studies that, in a comprehensive manner, examine longevity and k

MATERIALS AND METHODS

Data collection and study population

This is a nationwide study conducted on patients who underwent isolated CABG between January 1996 and December 2012 identified through Danish national administrative registries. Denmark has ~5.6 million inhabitants. All Danish inhabitants have free access to tax-supported health and elderly care including, primary care physicians and public hospitals. Each resident is supplied with a unique civil registration number which can be used to link information between different administrative registers holding information on health care usage [10]. Since 1977, all hospital admissions and discharge coding diagnoses and, since 1996, all surgical procedures in Denmark have been registered in the Danish National Patient Register. The classification of diagnoses in the register is in accordance with the International Classification of Diseases, 8th revision (ICD-8) until 1993 and the 10th revision (ICD-10) from 1994 [11]. All surgical procedures are coded with one or more codes depending on the type and scale of the procedure. Surgical procedures have been registered according to the Nordic Medico-Statistical Committee (NOMESCO) classification of surgical procedures (NCSP) used in the Nordic countries. Through the Danish National Patient Register, we identified all patients undergoing first time isolated CABG, their preoperative comorbidities and all hospital admissions postoperatively in a 17-year period from January 1996 to December 2012. We used the following NCSP codes to define patients undergoing isolated CABG: KFNA, KFNb, KFNC, KFND and KFNE. Patients living in a nursing home prior to surgery were excluded as well as patients having concomitant valve surgery, redo CABG or other cardiac surgical procedures. We classified urgency of surgery into three groups: emergency surgery (defined as surgery within 24 h after acute admission), urgent surgery (defined as patients who have not been electively admitted for operation but who require surgery on the current admission for medical reasons) and elective surgery. We calculated Charlson’s score for each patient to get an indication of the burden of comorbidities within each age group. Charlson’s score is derived from assessment of 19 disease categories weighted according to their prognostic impact on patient survival. The patients were divided into three groups according to their Charlson’s score: Score 0 (patients with no comorbidities), Score of 1–2 and Score ≥3. Alcohol abuse was defined as patients having diagnoses with diseases caused by alcohol. The following ICD-10 codes were used: Z721, Z714, K70, K860, G312, G621, G721, L278 and I426. Liver disease was defined from the following ICD-10 codes: K70–77, B15–19, C22, Z944, Q618a and I982. To identify patients with diabetes, the Danish National Prescription Registry was used. This register contains valid information about the use of medications in Denmark since 1994, where all claimed prescriptions, date of dispensation, strength and quantity have been registered [12]. The patients were identified by their use of glucose-lowering medications.

Using validated methods, Statistics Denmark has registered patient-level data on all nursing home admissions in Denmark since 1994. The register is based on the civil registration number and home addresses of residents in Denmark. These home addresses are linked to whether they match a nursing home address. The registry holds information on dates of admission and end of care for every resident admitted to a nursing home or a nursing apartment. We used this register to identify all permanent nursing home admissions in the study period. In 1987, the Danish government started a campaign aimed to enable people to stay in their own homes for as long as possible. Since then, not a single nursing home has been built, but instead there have been built complexes with nursing apartments, which in Denmark is the substitute for a nursing home [13]. Eligibility criteria for these complexes are similar to nursing homes and, more importantly, both types of care facilities are captured by our methods [14]. Thus, we defined living in a nursing home as either being a resident in a nursing home or in a nursing apartment as these two groups have similar need for help and care in daily life. The study population was divided into five different age groups <60, 60–69, 70–74, 75–79 and ≥80 years of age. The patients were followed for up to 17 years.

We conducted a subanalysis on home care usage for all patients postoperatively, in the period from 1 January 2008 to 31 December 2012, as data on home care usage in Denmark has not been registered in a nationwide database before that time. We excluded all patients who received home care preoperatively to be able to evaluate the impact of the operative procedure on the need for home care.

Eligibility criteria for home care and permanent nursing home admissions

All residents in Denmark irrespective of age, wealth or income are eligible to receive personal care in accordance with the Consolidation Act on Social Services. The Danish legislation includes care services in the form of home care, which can be given as practical help, e.g. help with groceries, cleaning or laundry or as personal
assistance with, e.g. medications, bathing, wound care, clothing and so forth. No minimum requirements are given for the extent of help needed. Furthermore, the legislation includes care in nursing homes [15]. All residents receive a home visit within 7 days from a community nurse after a assistance is requested. Help is provided after concrete and individual multidimensional assessment which includes social, psychological and home conditions, possibilities of self-determination and functional ability, assessed with the Barthel index [15]. Furthermore, all residents in Denmark above the age of 75 years are offered preventive home visits two times a year to ensure that those in need of care receive the help they require. In those cases where home care exceeds 20 h a week or citizens are unable to take care of themselves in their own homes, a nursing home/apartment is offered. Acceptance of this offer is entirely up to the recipient. Each municipality has a nursing home guarantee, which means that those citizens eligible for a nursing home/apartment receive an apartment within 2 months after a decision has been made.

Data analysis

Baseline demographics, clinical and procedural characteristics are presented as means with standard deviation for continuous variables and percentages for categorical variables. The χ² test was used for categorical variables and one-way analysis of variance for continuous variables. Kaplan–Meier estimates were used for the survival analysis. A cause-specific Cox proportional hazard regression model was constructed to identify predictors for being a resident in a nursing home 1 year after surgery. We chose the cut-off point of 1 year as this has been shown to be the time where patients ≥80 years have recovered after surgery and their health-related quality of life (HRQOL) is comparable with the background population [16]. The regression model was adjusted for 13 variables: age, sex, urgency of surgery, preoperative myocardial infarction (MI), diabetes, chronic obstructive pulmonary disease, peripheral artery disease, alcohol abuse, liver disease, preoperative heart failure (HF), chronic renal insufficiency, preoperative atrial fibrillation (AF) and preoperative stroke. Aalen Johansen estimates were used to estimate the cumulative incidence of nursing home admissions and the need of home care usage. We compared the cumulative incidence of being a resident in a nursing home and receiving home care postoperatively with the background population by using information from Statistics Denmark. A patient journey for the study period was constructed for patients ≥80 years of age. Five variables were used to examine day to day changes: dead, resident in a nursing home, living at home, admitted to a hospital and censored. Hospital admissions were admissions due to all causes in the years after CABG. A P-value of <0.05 was considered statistically significant. All data management was performed using SAS software (SAS Institute, Cary, NC, USA; version 9.4). Statistical computing and graphics were performed using R (R Core group, version 3.0.2).

Ethics

Approval was obtained from the Danish Data Protection Agency for the use of personal data (ref 2007-58-0015/GEH-2014-014 I-Suite nr: 02732). When conducting a retrospective registry study in Denmark, there is no requirement for ethical approval or informed consent from the patients.

RESULTS

A total of 39,343 patients who underwent CABG during 1996-2012 were identified. Of these, 343 patients were living in a nursing home prior to surgery and were excluded; an additional 513 patients were excluded due to lack of data and short follow-up, usually a few days. These patients were all non-Danish citizens operated in Denmark. The final study population therefore comprised 38,487 patients of whom 1455 (3.8%) where ≥80 years of age. Preoperative and demographic characteristics of the study population are presented in Table 1. The mean age was 65.3 (±9.5) years. Males were by far the largest group, accounting for 80% of the total population. The proportion of women increased with increase in age, from 14.7% in the youngest age group to 28.9% in patients ≥80 years of age. Compared with the younger age groups, patients ≥80 years of age more frequently had higher Charlson scores, HF, AF and preoperative MI; and substantially more underwent urgent or emergency surgery (24.5% for age ≥80 years vs 17.2% age <60 years). The proportion of patients with alcohol abuse and diabetes was lower in the elderly compared with the younger patients.

Outcomes

The overall 30-day mortality rate was 2.8%. The mortality rate at 30 days and 1 year increased with increase in age from 1.2 to 7.8% and from 2.2 to 14.1% in patients <60 and ≥80 years of age, respectively (Fig. 1). At the 1-year follow-up, 0.1% of patients <60 years, 0.2% of patients 60–69 years, 0.4% of patients 70–74 years, 0.5% of patients 75–79 years and 1.4% of patients ≥80 years were living in a nursing home (Fig. 2). We followed the patients for a median of 9.9 years to see how many of the patients came to live in a nursing home. The cumulative incidence rates of patients admitted to a nursing home at 5 and 10 years after CABG were 0.4 and 1.0% (66 years), 1.1 and 3.5% (60–69 years), 2.7 and 7.3% (70–74 years), 3.1 and 9.2% (75–79 years) and 7.5 and 16.8% (≥80 years), respectively (Fig. 3). The prevalence rates for the three oldest age groups in the general population in Denmark were as follows: for people aged 70–74 years 5.3% and 11.3%, for people aged 75–79 years 11.3% and 21.4% and for people ≥80 years 21.4% and 38.8%, respectively. Main predictors for nursing home admission after CABG were as follows: age ≥80 years [hazard ratio (HR) 17.8, 95% confidence interval (CI) 7.4–42.8], female sex (HR 1.7, 95% CI 1.1–2.6), HF (HR 1.6, 95% CI 1.0–2.4), previous MI (HR 2.0, 95% CI 1.3–3.2) and previous stroke (HR 3.3, 95% CI 2.1–4.9); neither urgent nor emergency surgeries were significant predictors for living in a nursing home 1 year after CABG.

We conducted a patient journey for patients ≥80 years of age (Fig. 4). A total of 15.4% were still admitted or had been readmitted to the hospital after 30 days. The proportion of patients hospitalized reduced gradually over the next 5 months and stabilized at around 15%. We followed the patients for 5 years (Fig. 5). The number of patients admitted to a nursing home increased steadily, but at the same time the number of admissions to a hospital decreased, mean 0.87 ± 0.34% over 5 years, and most of the patients alive and with 5 years of follow-up were living in their own homes.

We conducted a subanalysis on home care usage postoperatively in the period from 1 January 2008 to 31 December 2012. We identified 8748 patients. A total of 556 patients (6.4%) were excluded as they received home care preoperatively. The sub-study population therefore comprised 8192 patients. Among
these, 1976 (24.1%) were <60 years, 3270 (39.9%) were 60–69 years, 1471 (18.0%) were 70–74 years. One thousand and fifty-six (12.9%) were 75–79 and 419 (5.1%) were ≥80 years of age. Almost all patients requiring home care received it within the first 30 days (Fig. 6). At the 1 year follow-up, 4.2% of patients <60 years, 7.9% of patients 60–69 years, 14.4% of patients 70–74 years, 18.5% of patients 75–79 years and 29.1% of patients ≥80 years had received home care. The prevalence rates for the three oldest age groups in the general population in Denmark were as follows: for people aged 70–74 years 4.4%, 75–79 years 11.4% and ≥80 years 34.4%.

**DISCUSSION**

We analysed short- and long-term outcomes, home care usage and permanent admissions to nursing homes according to age in a nationwide cohort of patients selected for isolated CABG, in a 17-year period from 1996 to 2012. The key findings of our study were as follows: (i) only a few patients were living in a nursing home 1 year after surgery irrespective of age, with only 1.4% of patients ≥80 years being residents in a nursing home; (ii) a substantial proportion of patients needed home care postoperatively, especially among the elderly with 22% of patients ≥80 years needing home care 30 days after surgery; (iii) patients who survived beyond the first 4 months after CABG were living in their own homes for many years with minimal help irrespective of age, compared with the general population and (iv) being a resident in a nursing home 1 year after CABG is dependent on the patient’s age, sex and preoperative comorbidities.

The traditional indicators of success after cardiac surgery such as mortality and morbidity are important indicators of operative

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PAD: peripheral arterial disease; HF: heart failure; CRI: chronic renal insufficiency; COPD: chronic obstructive pulmonary disease; MI: myocardial infarction; SD: standard deviation.

Figure 1: Survival. One-year follow-up.

Figure 2: Cumulative incidence of nursing home admission; 1-year follow-up.
outcome, but prolonged survival with highly impaired function is not a favourable outcome. Improved HRQOL is an important aspect for many patients in their decision-making process before surgery and must be one of the main goals when operating on elderly patients [8]. Jensen et al. found that despite lower preoperative SF-36 scores compared with the background population, elderly patients showed significant improvements in HRQOL, being superior to the same population on follow-up after CABG. They also found that preoperative depressive symptoms did not worsen after surgery [17]. However, elderly patients have longer recovery time after CABG compared with their younger counterparts, which is reflected in lower SF-36 scores in physical functioning, role physical, role emotional and general health domains. The steepest improvements in most SF-36 categories occur during the first 6 months, which then stabilizes after a year [18]. These findings are consistent with Conaway et al. [19] who reported consistently lower physical limitation scores on the Seattle Angina Questionnaire for patients >75 years compared with younger patients until 1 year after CABG. Slower recovery can be expected in elderly patients due to more comorbidities and decreased physical reserves. This is being reflected in a number of studies that have shown that a substantial proportion of elderly patients is discharged to a continuing care facility compared with younger patients after cardiac surgery, ranging from 16 to 39% in patients ≥80 years of age [6, 7, 20, 21]. In one of the largest studies to date on this topic, including more than 8000 patients ≥80 years of age undergoing isolated CABG, 12% were discharged directly to skilled nursing facilities and another 28% were discharged to acute care facilities [6]. However, this study suffers from a short follow-up time and missing information on how many patients became permanent residents in nursing care facilities. We have shown that substantial proportions of patients have need for minimal help in terms of home care postoperatively (Fig. 6). This is especially true for elderly patients where 18.5 and 29.1% of patients 75–79 and ≥80 years of age, respectively, needed home care within the first year after CABG. Most of the patients were able to stay in their own homes and very few patients became permanent residents in nursing homes after CABG irrespective of age. Only 1.4% of patients ≥80 years of age were permanent residents in a nursing home 1 year after surgery and the cumulative incidence rates after 5 and 10 years of follow-up were 7.5 and 16.8%, respectively (Figs 2 and 3). These findings are encouraging and show that despite the fact that elderly patients have a longer recovery time after CABG and a substantial proportion of these patients are discharged to continuing care facilities, very few survivors become permanent nursing home residents. Our patient journey also shows that not only are they living in their own homes but very few become hospitalized in the years after surgery.

Factors found to be associated with non-home discharge after cardiac surgery are age, female sex, acuity of surgery, poor nutritional state and preoperative stroke among others [20, 21]. To our knowledge, no studies have looked at predictors for permanent residency in a nursing home after CABG. We found that the major predictor for being a resident in a nursing home 1 year after CABG...
Besides age was preoperative stroke. Other major predictors were female sex, preoperative MI and preoperative HF. Surprisingly, neither urgent nor emergency surgeries were significant predictors in our study. Other studies have shown that acute surgery is a major predictor for early mortality [1, 3, 22]. One could speculate if those patients who in fact were candidates for a nursing home simply died within the first year after surgery. This could be the explanation why we did not find acute surgery to be a predictor for living in a nursing home.

The present study showed that long-term mortality at 1 year increased with age, from 2% in the youngest age group to 14.1% in patients ≥80 years of age. These results are in accordance with other studies. McKellar et al. [23] showed in a meta-analysis, including 66 studies, a 1-year mortality rate of 14% in patients ≥80 years of age. While mortality remains a valuable measure of success, our results indicate that the 30-day mortality rate is not a good quality measure for CABG, especially among elderly patients. Our survival analysis showed that the 30-day mortality rate in patients ≥80 years of age was 7.8% but increased to 12% by 4 months after surgery, after which the mortality rate seemed to flatten out. It has been demonstrated that the mortality rate after cardiac surgery converges with the mortality rate in the general population after 140 days, irrespective of the EuroSCORE or type of surgical procedure [24]. Furthermore, a recent study has shown that despite improvement in the 30-day mortality in cardiac surgery over the years, the 1-year mortality is unchanged [25]. Therefore, a consideration for a new benchmark to assess the quality of life after CABG is warranted. Despite relatively high 1-year mortality rates, long-term survival is comparable with the age-matched background population [1, 3, 5]. We showed in a recent study that the median survival for patients ≥80 years after isolated CABG is just over 7 years, and 25% are still alive 11 years after surgery now with a median age of 92.5 years [1]. Elderly patients enjoy good HRQOL in the years following surgery and we have shown that most of these patients are living in their own homes with minimal assistance [17–19]. To address the relatively high operative mortality in the oldest patients after CABG, improvements in patient selection and procedural performance could lead to reduction in early mortality.

**Strengths and limitations**

The strength of this study is that it is a nationwide cohort study including all consecutive patients undergoing isolated CABG surgery in Denmark during a 17-year period. The study population is large and has a long follow-up time (mean follow-up 9.9 years). There are, however, several limitations inherent in the observational design of the study that need to be acknowledged. There is most likely a selection bias with regard to patients who were referred to surgery, especially among the elderly population. It is therefore important to recognize that patients selected for surgery are not necessarily representative of the background population in Denmark. Information on comorbidity is based on discharge diagnoses that may vary in quality; e.g. we do not have any information about the plasma creatinine levels or ejection fractions in those patients having chronic kidney and HF and therefore we have no information on the severity of the disease. We only have data on home care for the last 5 years of the study period. We do not have any information on how long or how much home care each patient received as these data were not accessible. Data concerning nursing homes have some limitations. Not all residents change their permanent address as they move to a nursing home and are therefore not included in the data set. This applies especially for a resident with severe dementia where there is a healthy spouse who takes care of mail and daily practical aspects of life. It is estimated that 10% of patient with severe dementia do not change their addresses as they move to a nursing home. In terms of social care in relation to home care and nursing homes, there is a significant difference between countries, not only due to economic restrictions but also due to cultural beliefs. Relocation to a nursing home could, for example, be considered discreditable and embarrassing for the individual and his family in some countries. In Denmark, the evaluation prior to home care and nursing home admissions are based on the citizen’s functional abilities and, therefore, the need for home care and nursing homes is a proxy for functional outcome after CABG. Due to the fact that every resident has access to this service irrespective of age, wealth or income makes knowledge about home care and nursing home admissions reliable information on the degree of assistance elderly patients might require postoperatively. There may be unmeasured confounders that were not controlled for in our regression model which could influence the HR for being a resident in a nursing home 1 year after surgery.

**CONCLUSION**

The majority of all patients selected for CABG surgery in Denmark during 1996–2012 including the elderly were able to live in their own homes without the need of home care for many years after CABG. Elderly patients seem to enjoy HRQOL comparable with the age- and sex-matched background population. The risk of nursing home admission was small and dependent on the patient’s age, sex and preoperative comorbidities.

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