Surgical Innovations: Impact on the Quality of Life of the Older Patient

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In the not too distant past, major surgery was rare in the elderly population. A revered professor often told students of an 83-year-old man who was initially denied a gastrectomy for gastric cancer. The surgeons were worried because of the man’s advanced age and believed it futile because of his limited life expectancy. They relented when the man pleaded that there would be no one to help take care of his mother if he died! Although the case might be apocryphal, the point was clear: surgery should be decided on the merits of the case and not just the age of the patient. These days, this story has lost some of its didactic strength: indications for surgery are being extended to include older patients for many major operations that were limited to younger patients not long ago. In 1996, people past the age of 65 years accounted for 35% of all operations in the United States and these numbers continue to grow as the population ages [1]. In 2002 to 2003 there were 4.2 million hospital stays with at least one procedure done in those older than 75 years, compared with 3.4 million in 1992 to 1993 [2].

Surgery is now routinely performed for conditions that interfere with quality of life as much as to prevent mortality. Decisions about surgery in the very elderly (age 85 years and older) are complicated. The very elderly vary widely in function, capability, and prevalence of comorbid diseases. Efforts to establish biologic age independent of calendar age have not proven useful. The risk/benefit ratio of surgical interventions becomes more acute with advancing age as the risk for complications/mortality of operations increase. Patients and their physicians have to weigh the often significant risk of an intervention with its benefits. Often these decisions are made in the absence of controlled clinical trials or high quality observational studies. Elective surgery is performed in even the very elderly (1) to improve chronic...
conditions that impair function and health-related quality of life (HRQOL) but do not directly impinge on mortality (eg, cataract removal, joint replacement), (2) to improve conditions that can cause early mortality and impinge on function and HRQOL (eg, cardiac surgery, some cancer surgery [lung], or (3) that have significant effects on mortality but do not impinge directly on function and HRQOL (eg, aneurysm repair, some cancer surgery [colon, breast]). The risk/benefit of these types of surgery varies by condition of patient (expected longevity, comorbid illnesses), type of surgery (morbidity and mortality), and effect on function and HRQOL. For the oldest patients, the issues of function and HRQOL become more important as major surgery can enhance physical independence or worsen it as a result of surgical morbidity and complications. As surgical techniques (eg, minimally invasive surgery and laparoscopic surgery) and pre- and postoperative care improve, however, the risk for mortality and decreased HRQOL declines and expands the range of indications for surgery in older patients.

Impairment from chronic disease increases in prevalence with age. The common conditions that interfere with activity are listed in Fig. 1. Surgical amelioration of the impairment caused by these conditions has increased in the past 20 years as the United States population has aged. In 2002 to 2003, the major cause of limitation in the elderly population was arthritis, with a rate of 267 in 1000 in those past 85 years, and 171 in 1000 in those past 75 years. Not surprisingly, joint replacement surgery in these age groups has been increasing over the 10-year period before 2002 to 2003, with a rate in those past 75 years of 16.9 in 1000 [2]. Heart disease (defined in the survey as heart disease, stroke, hypertension, or other circulatory disease) becomes more prevalent and disabling with age and is the leading cause of mortality. The rate of revascularization procedures increases from 7.89 procedures per 1000 to 1.28 per 1000 in those older than 75 years in the 10-year period before

![Fig. 1. Chronic conditions causing limitation of activity by age group. From Centers for Disease Control National Center for Health Statistics, Health, United States, 2005.](source)
2002 to 2003. Vision and hearing loss increase dramatically as age advances, and vision impairment is the third leading cause of impairment in those past 85 years. Cataract removal remains the most common procedure in this age group. Most disability is caused by age-related disease and not by aging [3]. Indications for surgery therefore should be based on an individual’s overall health, surgical risks measured against benefits, and impact on HRQOL, regardless of age. A growing literature examines the effects of surgery on the HRQOL in the elderly population in relation to disease and underscores the potential benefits of surgical interventions.

**Risks of surgery in elderly patients**

The surprising feature of the increase in the rate of surgery in older patients is that the concern for risk for complications is unabated. With increasing age and accumulated chronic diseases, physiologic reserves decline, leaving older individuals at greater risk for adverse clinical outcomes under conditions of stress. The stress of surgery (and anesthesia) is great and can have catastrophic effects on high-risk elders. Postoperative complications occur more frequently in the older patient. For example, in some studies, significant adverse events that occur more often in older patients include stroke and myocardial infarction [4–6]. Additionally, elderly patients are susceptible to common in-hospital complications: adverse drug events [7], delirium [8], functional decline [9], falls, incontinence, pressure ulcers, and so on.

In series of major noncardiac surgery, the mortality and complication rates increase dramatically with age (Fig. 2), although comorbid disease/surgical urgency rather than age are the most significant factors [3–5,10,11]. In the general surgical population older than 65 years of age, severity of illness is a better predictor for morbidity and mortality than is age [11]. The safety of surgery has been steadily improving, and the risk for complications and mortality have been declining steadily over the past 30 years as surgical

techniques and hospital care have improved [12]. Mortality statistics, however, vary by operation and patient comorbidities. Several recent reports of mortality for surgery in the over–80-year group illustrate recent trends. In a review of a cancer registry of 5390 patients who underwent resectional surgery between 1987 and 2000 in the Netherlands, postoperative mortality increased with age from 5.4% in patients aged 80 to 84 years, to 9.1% in patients aged 85 to 89 years, and 14.4% in nonagenarians [10]. Variation by disease was also marked, with stomach cancer having a high mortality rate of 15.8%, and endometrial, breast, and kidney cancers having mortality rates of 0.5%, 1.7%, and 4.2%, respectively. In a large Veterans Affairs (VA) study of nearly 600,000 surgeries from 1991 to 1999, those older than 80 years had a 30-day mortality rate of 8% versus 3% for those younger than 80 years of age. Again, there was significant variation by disease/procedure, with a mortality rate of less than 2% for hernia, transurethral prostatectomy, knee replacement, and carotid endarterectomy. Emergency surgery and comorbid illness were stronger predictors of mortality and morbidity than was age [5]. In a survey of noncardiac elective surgery, mortality for octogenarians was 2.6% with a morbidity rate of 12.5% [4].

It is not easy to dissect out the effect of age on morbidity/mortality, however, independent of comorbidities. Data on outcomes of major surgical cases in the very elderly have been sparse; randomized trials with enrollment of very old patients are rarely reported, as a significant portion of elders are not able to undergo a major procedure. Excellent outcomes, however, are found in surgical series for even the very old, although a refined definition of criteria for success of surgery in this age group is necessary to judge the impact of the surgery on HRQOL. The goal of care for patients of advanced age concerns quality of life as much as survival. The mortality rate for elective surgery thus remains generally low, even in those older than 80 years, and, although the decision to operate is more difficult to make in an older person, age alone should not preclude consideration.

In addition to the decline in mortality, there has been a shift in the benefits of surgery and life expectancy. Those expecting to live for more than 10 years will likely benefit significantly from preventive surgery. Men and women in their late 70s or possibly early 80s thus may live long enough to realize the full benefits of a curative operation. The line at which preventive surgery is no longer useful on the basis of age or life expectancy is getting increasingly hard to draw. Life expectancy at any age is influenced by chronic diseases and functional status. Functionally impaired and disabled patients have a shorter life expectancy than robust and functionally independent patients. Table 1 lists recent US figures for life expectancy at given ages. For patients who survive at least 6 months after a general surgery procedure, life expectancy matches their age cohort who did not have surgery [13,14].
Health-related quality of life as an outcome for surgery

Whether for cure or symptom relief, surgical interventions are performed with the intention of improving a person’s overall health. In chronic disease states, the definition of improvement is less straightforward than survival and the morbidity of surgery. Death has been the best studied outcome in the surgical literature; however, it is infrequent and does not distinguish levels of physical or cognitive impairment among survivors. Long-term survival rates for cancer surgeries are useful for long-term interpretation of success, yet this is not a pertinent outcome for many surgeries, such as cataracts or joint replacements. In the past 20 years, together with the increase in surgery for elderly patients there has been a shift in focus on health outcomes. Health status and HRQOL have become key concepts for health outcomes. HRQOL was defined by Wenger and Furberg as:

“Those attributes valued by patients including: their resultant comfort or sense of well being, the extent to which they were able to maintain reasonable physical, emotional, and intellectual function; and the degree to which they retain their ability to participate in valued activities within the family, in the workplace and in the community” [15].

Health status includes those features commonly evaluated as part of a Comprehensive Geriatric Assessment [16]; it is a measure of illness and its effect on a person’s life: how they feel, how they function, and the severity of symptoms and their impact on functioning. HRQOL includes health status, but also stresses the person’s satisfaction with current health status (Fig. 3) [17,18]. Box 1 includes the main dimensions assessed by measurement scales for HRQOL. Certain issues for QOL become more important in the older age groups, specifically cognition and level of physical functioning. Perioperative or postoperative complications (eg, stroke or loss of cognition) have catastrophic impacts on QOL. Many of these patients lose the ability to live independently and require institutional care following hospital

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discharge. Despite this potential for adverse impact on HRQOL, few studies of surgical procedures include site of discharge or long-term effects of surgery on physical and cognitive functioning.

One example of health status is the inability to drive a car because of cataracts, whereas the degree to which this causes personal distress represents an aspect of HRQOL. The degree to which patients differ in their degree of dissatisfaction may vary widely, although the degree of impairment may be the same. After correction of the cataracts the change or improvement in

**Box 1. Dimensions of health-related quality of life**

**Primary dimensions**
- Physical functioning
- Social functioning

**Psychologic functioning**
- Overall life satisfaction/well being
- Perceptions of health status

**Additional dimensions**
- Cognitive/neuropsychologic functioning
- Sexual functioning
- Sleep
- Pain
- Symptoms
- Spirituality

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HRQOL therefore also differs between individuals. These differences in perception explain the confusing findings in some cataract trials that a significant number of patients do not show improvement in HRQOL after successful cataractectomy [19]. Not all successful surgical interventions produce immediate positive effects on QOL. After surgery for abdominal aortic aneurysm (AAA), for example, the pain and disability of recovery has a negative effect on short-term functioning but remains a reasonable trade-off for the resolution of a life-threatening condition [20]. HRQOL hence is best evaluated over an adequate period of time to judge the sustaining effects of surgery. Often studies of HRQOL include measurements at varying time points to capture this information.

Quality of life measurement

Many scales are used for general measurement of HRQOL. Some of these scales are questionnaires designed as a global health instrument. Among the commonly used measures included in studies of surgery and other health interventions is the short-form-36 (SF-36) and its shortened version, the short-form-12 (SF-12). These scales measure domains of mental and physical health: physical functioning, role physical (problems with work or other daily activities as a result of physical problems), bodily pain, and general health perception. The mental health sphere consists of perceived mental health, role emotional (problems with work or other daily activities as a result of emotional problems), social function, and vitality. This scale has been used in numerous medical studies and in some studies of surgical procedures [21]. The usefulness of HRQOL scales generally are evaluated on the basis of reliability, sensitivity to change, and interpretability [18]. General scales of HRQOL such as the SF-36 can be compared across settings and diseases, but may miss the subtlety of specific disease states. Given the specific nature of satisfaction with level of symptoms in a specific disease, many different disease-specific HRQOL scales therefore have been developed, with one investigator postulating the existence of at least 1000 different scales in the literature [22].

Measures of HRQOL and health status are primarily patient reported because of the subjective nature of the evaluations. There are significant effects of age on perception of health and disease. Using the SF-36, elderly patients (> 70 years) undergoing surgical procedures rate their global health perception similar to the younger patients undergoing similar procedures, despite lower scores in role function, poorer energy and fatigue scores, and poorer physical function [23]. The multidimensional nature of the scales reflects postoperative differences between young and old that would not be apparent if global health perception alone were used.

A good example of the use of a general scale (SF-36 in this case) for measurement of surgery-related HRQOL is exemplified by a study performed in the 1990s in Boston [20]. HRQOL was measured prospectively...
in 454 consecutive patients (mean age, 67 years) undergoing three types of surgery: total hip arthroplasty, lung resection for non-small cell cancer, and AAA repair. Among the patients undergoing surgery, 390 completed all interviews preoperatively and at 1, 6, and 12 months postoperatively. Not surprisingly, physical function and role limitations caused by health problems were worse at the 1-month postoperative interview during recovery from the acute surgery (Fig. 4). At 6 and 12 months, however, significant gains were made after all three surgeries. There were differences, however, in the responses by type of surgery. In hip patients, a huge benefit was seen in bodily pain at 1 month and was sustained to 12 months, and functional improvements continued to the 12-month interview. Lung resection patients had worsening of health perception at 6 and 12 months after surgery, reflecting other aspects of their disease. Those undergoing AAA repair had significant declines in physical health at 1 month, but returned to preoperative levels by 6 months. Elective surgery for an essentially asymptomatic disease AAA thus had only an interval effect on HRQOL, whereas surgery for a symptomatic condition (osteoarthritis of hip) showed interval worsening but long-term improvements in HRQOL. For a chronic and progressive disease such as lung cancer, the interval decline shows recovery, but ongoing morbidity from the lung disease, resection, and comorbidities contributes to slow decline. HRQOL scales that were not pertinent to the procedures did not change much in all three groups: mental health scores did not

vary much after surgery, but bodily pain scores improved to normal as recovery from the acute surgery occurred [20].

**Health-related quality of life and joint replacement surgery**

Osteoarthritis (OA) is the most common articular disease of older persons. Significant pain associated with OA is reported by approximately 40% to 60% of those older than 65 years, and it leads to decreased physical functioning [24]. Decreased activity secondary to arthritis is reported in 17% of those aged 75 to 85 years and in more than 25% of those older than age 85 years (see Fig. 1). Disabling OA of the weightbearing joints commonly leads to replacement, with 418,000 total knee arthroplasties (TKA) and 220,000 total hip arthroplasties (THA) performed in the United States in 2003 [2]. Joint replacement is indicated for patients who have intractable pain and functional disabilities who have not had adequate relief from conservative treatment [25].

Elective joint replacements have low rates of morbidity and mortality. In a review of Medicare data on 61,568 patients who had a THA in 1995 to 1996, the overall 90-day mortality was 1%, and the rates of complications were 0.9% for pulmonary embolus, 0.2% for wound infection, 4.6% for hospital readmission, and 3.1% for hip dislocation [26]. Increasing age, male gender, race, and comorbidities were associated with increased mortality and morbidity. In the VA series of 1096 operations in patients older than 80 years, the 30-day mortality for THA was 6.8% (compared with 1.3% in the younger group) [5].

For TKA, rates of mortality are lower. In a Mayo Clinic series of 22,540 patients, 30-day mortality was 0.21%. Older age, cardiovascular comorbidity, and bilateral revision were associated with an increased rate of complication [27]. In a VA series of 821 operations in patients older than 80 years, the 30-day mortality was 1.7% (compared with 0.4% in those younger than 80 years) [5].

HRQOL and joint replacements have been well studied. Older individuals who have severe OA have poorer SF-36 scores for pain, physical function, and role-physical (eg, problems with work or other daily activities as a result of physical health) when compared with age-matched population norms [28]. These scores improve remarkably after joint replacement (see systematic review in [25]), often reaching or exceeding population norms after 6 months [20,28]. HRQOL improvements after joint replacement are maintained even in the older age groups. In a prospective Canadian series of 454 patients receiving THA and TKA, all patients, regardless of age, showed significant and comparable improvements in pain, function, and stiffness; however, patients in the over–80-years-old group did not match the small improvements in health and mental health dimensions of the SF-36. These improvements, however, were comparable with those seen in age-matched norms [29].
For elective joint replacement, surgical intervention has been proven to be highly beneficial for elders in HRQOL, and overall risk remains low. Only approximately 10% of patients meeting clinical criteria for joint replacement, however, are willing to consider the procedure [30]. Use rates for THA and TKA have been increasing, but the mean age of recipients of joint replacements has not increased despite the aging of the population [29].

Minimally invasive techniques for THA have been introduced and promise less pain and more rapid recovery time. In a prospective randomized trial of 219 patients undergoing THA, there were no significant benefits in the immediate postoperative period on hospital length of stay or walking speed [31,32]. The patients in this study were younger (mean age, 67 years) and at lesser risk for complications than older patients. These techniques offer hope of improving outcomes in the oldest patients who have less physiologic reserve.

Health-related quality of life and cardiac surgery

Heart disease is the second most common cause of disability after arthritis in the very old. Coronary artery disease is prevalent in those older than 80 years and accounts for a quarter of morbidity and more than half of mortality in this age group [33]. Open heart surgery is becoming common in octogenarians and is even reported in 90-year-olds. Surgical mortality in this group is expected to be higher in this age group than other elective surgery because of the degree of risk involved, although mortality has steadily decreased as techniques have improved. In large series, the in-hospital mortality for octogenarians undergoing coronary artery bypass graft surgery (CABG) decreased from 11.5% (24,461 operations, Medicare data) in the years 1987 to 1990 [34] to 8.1% (64,476 operations, National Cardiovascular Network data) in the years 1994 to 1997 in the United States, and the mortality risk by age was nearly linear (Fig. 5) [35]. Data from the period 2000 to 2003 reveal a decrease of mortality to 6.5% (35,761 operations, Society of Thoracic Surgeon’s National Cardiac Database) [36]. Age does predict higher mortality and morbidity, although it is only one of several factors. Elderly patients without comorbidities had similar rates of mortality as younger patients [35].

Although the survival benefit for surgical revascularization has been shown for younger patients [37,38], the data on those 75 years of age and older are not as clear. The recent Trial of Invasive versus Medical Therapy in Elderly Patients (TIME) with chronic symptomatic coronary artery disease (CAD) randomized patients older than 75 years to medical therapy or invasive therapy, which included either CABG or percutaneous coronary intervention. At 1 year, despite an early advantage to revascularization, there was no difference for QOL, survival, MI, or symptoms, but there was a 43% revascularization rate for refractory angina in those randomized to medical therapy.
At 4 years, survival rates were better for those who had revascularization within the first year, and the improvements in QOL (as measured by SF-12 and CAD-specific instruments) were maintained in both groups [40]. Although many studies have evaluated mortality and morbidity in CABG, few have evaluated QOL in the elderly population. Using the Nottingham Health Profile, health perception improved after bypass surgery in patients older than age 70 years. Energy levels improved also, although older patients and those who had postoperative events had significant fatigue. In general the improvement in measured QOL was less for patients undergoing CABG than for valve replacement [41]. In a Swedish sample of octogenarians, quality of life as measured by the SF-36 in the long-term survivors (mean, 8.3 years postsurgery) was comparable to age-matched norms [42]. Percutaneous coronary interventions have also shown sustained improvements in the physical abilities and pain dimensions of QOL and remain an excellent option for those who have limited vessel disease [43].

Valve replacement surgery has greater risks and benefits in the very elderly. Rates for short-term mortality in octogenarians range from 8% to 20%, depending on the valve and comorbidities [44]. Limited data in those older than 90 years suggest mortality rates greater than 15% [45]. In the National Cardiovascular Network, mortality rates for those older than 80

Fig. 5. Mortality and morbidity rates from cardiac surgery increase linearly with age. National Cardiovascular Network. Diamond, mortality; square, renal failure; triangle, neurologic events. From Alexander K, Anstrom K, Muhlbaier L, et al. Outcomes of cardiac surgery in patients ≥80 years. Results from the National Cardiovascular Network. J Am Coll Cardiol 2000; 35:731–8; with permission.
years in 1994 to 1997 were 4% for CABG, 7% for CABG with aortic valve replacement, and 18% for CABG with mitral valve replacement [35]. QOL in those surviving valve replacement is greatly improved, with improvement in New York Heart Association class [46] and SF-36 [47]. The SF-36 improvement at 18 months was significant in almost all QOL domains and was sustained at 18 months; the mean scores were comparable to the norms for healthy elders!

Although significant gains in technique have improved mortality and morbidity from cardiac surgery in the elderly population, it remains a significant risk. There are, however, significant benefits to be realized in HRQOL and mortality for this age group. These issues have to be carefully assessed in the evaluation of candidates for cardiac surgery.

**Health-related quality of life and cataracts**

Cataracts are the most common cause of visual impairment in the world, and in the United States an estimated 24.5% of those 70 years of age and older report having a cataract, with a prevalence of 5.1 million cataracts [48]. The prevalence of cataracts, defined as opacity of the lens, increases with age. Vision impairment from any cause has been associated with substantial activity limitations: difficulty walking, difficulty managing medications, difficulty preparing meals, and an increased incidence of falls [48].

There are no effective medical treatments for cataracts, and the functional impact of the cataract determines the indications for surgery: (1) visual impairment by cataract, (2) quality of vision insufficient to meet the patient’s needs, and (3) likelihood that the successful operation will improve vision [49]. The need for surgery thus strongly depends on the visual needs of the patient. Cataract surgery has improved over the last several decades and perioperative mortality is negligible. Preoperative clearance (consisting of electrocardiogram, complete blood count, electrolytes, blood urea nitrogen, and creatinine) in a series of more than 18,000 patients was shown not to be of benefit in predicting or preventing morbidity, even after stratifying for age [50].

Cataract extraction can markedly improve vision, with 72% to 92% of patients reporting improvement in visual function after surgery [51]. Improvement in vision-related QOL follows that of visual improvement, with as many as 89% of patients showing improvement on vision-specific HRQOL scales [52], although general measures do not always show as much improvement as vision-related scales [53,54]. Vision-specific scales show improvement in visual problems related to driving and distance estimation [55] and reading small print, watching television, seeing steps, cooking, reading traffic signs, and doing fine handiwork [56,57]. Removal of cataracts improves vision and vision-related quality of life with low risk. Morbidity and mortality are low despite its use in the very elderly and in those who have multiple chronic diseases.
Summary

As surgery has been extended into the elderly population, HRQOL has been appropriately added as a parameter to evaluate surgical success. Surgery remains of significant risk in older patients, and an estimate of the type of outcome, including morbidity, mortality, and HRQOL can aid in that decision. New techniques, such as laparoscopic or minimally invasive surgery show great promise for reduction in perioperative stress \[58,59\] and improved HRQOL \[60\] in younger patients, but have not been extensively used in the older and frail patients for whom the benefits potentially may be greater.

References


