Surgery in Nonagenarians: Morbidity, Mortality, and Functional Outcome

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Background. There are few studies that document the outcomes experienced by very old patients who undergo major surgery.

Methods. This is a case series and 7-year follow-up of 116 consecutive patients who were aged 90 years or older and underwent major surgery at a large university-affiliated community hospital. We describe the functional status, short- and long-term mortality, and predictors of mortality in this group of frail elders.

Results. The 116 nonagenarians in this study underwent 134 major operations. Sixty-three patients were admitted to the hospital from a nursing home. The most common surgical procedures were for hip fracture, lower extremity amputation, and abdominal problems. Nineteen patients died in the hospital following surgery, and 23 patients died within 30 days of operation. Follow-up at 7 years revealed that all but three patients had died. Survival was worse for patients admitted from nursing homes, those who were nonambulatory before surgery, and those with major or complete functional impairment.

Conclusions. Major surgery in nonagenarians is associated with a 20% perioperative mortality. Functional status and ambulatory ability are maintained in most patients. Whether to operate on these frail elders is a complex decision.

Key words. Frail elderly; operative surgery; mortality; activities of daily living; nursing homes. (*J Fam Pract 1995; 40:129-135*)

The elderly comprise the most rapidly growing segment of our population.[1] In 1990, there were 31.5 million persons over the age of 65 years in the United States, accounting for 12.5% of the population. By 2020, there will be 52 million elderly, representing more than 20% of the US population. Surgical procedures become more common as one ages. In 1991, 219 surgical procedures were performed per 1000 population in patients aged 65 years and older, compared with 107 per 1000 among those aged 45 to 64 years.[2]

Because of recent improvements in surgical and anesthetic techniques and increased longevity among a greater proportion of the elderly population, it is likely that even more surgery will be considered for patients in this age group. During the decade between 1981 and 1991, there was an increase in the number of surgical procedures performed among patients over age 65, whereas younger patients underwent fewer procedures.[2]

According to the National Center for Health Statistics,[3] the average remaining life expectancy of a 95-year-old white woman is 3.4 years. The benefits of surgical procedures in very old patients must be balanced against higher operative mortality and morbidity rates and the generally short life expectancy of these patients. Many patients in their tenth decade also have quality of life issues, such as severe cognitive deficits and other functional limitations, that should be considered before surgical procedures are recommended.

Much of the medical and surgical treatment of very old patients is based on the experience and results of treating much younger populations. Major textbooks of surgery make only fleeting reference to problems associ-

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ated with surgery in the elderly,[4,5] although there is now at least one textbook devoted to this issue.[6] Little research has been focused on the outcomes and quality of life of patients treated sugically in their 90s. The purpose of this study was to evaluate functional outcomes, perioperative mortality, and long-term survival of nonagenarians undergoing major operations in a community hospital.

Methods

The Medical Center of Central Georgia is a 500-bed community hospital affiliated with Mercer University School of Medicine in Macon. It provides inpatient medical and surgical care to residents of the city and surrounding rural counties.

Between October 1985 and April 1989, there were 535 admissions of patients 90 years or older to the Macon hospital. During this study period, 116 patients who were aged 90 years or older underwent 134 major surgical procedures. Only data from their first operation are included in the analysis. A major surgical procedure was defined as one performed in an operating suite with the patient under general or regional anesthesia; excluded were endoscopic procedures (including transurethral prostatectomy), pacemaker insertion, and all procedures performed with local anesthesia.

Demographic data (date of birth, sex, and race) were collected. Admission from a family residence or a nursing home was noted. The operation was considered "emergent" if the condition had the potential to be rapidly fatal and required surgery within 12 hours; "urgent" if the procedure was required for discharge but could be safely postponed for more than 12 hours; and "elective" if admission and operation were scheduled in advance and the condition was not life-threatening. The major diagnosis, surgical operation, and major complications were recorded. Rather than using standard definitions of diagnoses, operations, complications, and causes of death, we accepted the terms used by the attending physician in each case.

The patient's functional status and ambulatory ability were determined by compiling data from the admission history and physical examination and the progress, physical therapy, and nursing notes. Functional status determinations were based on the ability of the patient to perform activities of daily living (ADLs) and the level of nursing care the patient required. Each patient was classified as normal (requires no assistance), minimally impaired (requires intermittent or minor assistance with ADLs), severely impaired (requires assistance with most ADLs), or completely impaired (requires complete assistance with all ADLs). The ambulatory status of each patient was classified as either independent, ambulatory with assistance, wheelchair-bound, or bedridden. The preoperative functional and ambulatory assessments were based on the patient's condition in the days to weeks preceding any acute illness or trauma that resulted in hospitalization. Functional assessment and ambulatory status were reassessed for a final time at discharge. Discharge to a family residence or to a nursing home was noted.

Table 1. Admission Characteristics of 116 Nonagenarians Who Underwent Surgery

Characteristic	No.
Female	92
Age, y	
90–94	84
95–99	31
≥100	1
Place of residence	
Family home	53
Nursing home	63
Functional status	
Normal	29
Minimal impairment	48
Major impairment	24
Complete impairment	15
Ambulatory status	
Independent	31
Ambulatory with assistance	40
Wheelchair-bound	15
Bedridden	30

Deaths after discharge were verified through the Georgia Office of Vital Statistics. An attempt was made to verify by telephone interview the vital status of all patients not recorded as deceased by this office. All deaths that occurred within 30 days of the procedure or during the same admission as the surgery were considered perioperative mortality.

Perioperative mortality rates were compared by the χ^2 test of homogeneity. Survival curves were constructed by the Kaplan-Meier product limit method. Using the US Decennial Life Tables for 1979–1981, the expected survival curve was constructed for an age-, sex-, and race-matched cohort of the general population.[3] Statistical comparison of survival curves was performed by means of the logrank test.

Results

Admission Characteristics

Demographics and admission characteristics are listed in Table 1. The 116 patients ranged in age from 90 to 10

Table 2. Characteristics of Surgical Procedures Performed on 116 Nonagenarians

Surgery Characteristic	No.
Major surgery diagnoses	
Femur fracture	54
Lower extremity gangrene	20
Small bowel obstruction	10
Soft tissue wound	5
Cholecystitis/cholelithiasis	4
Inguinal hernia	4
Diverticulitis	3
Respiratory failure	2
Other	14
Surgical procedures	
Femur operation	54
Amputation	17
Colectomy/colostomy	5
Inguinal herniorrhaphy	4
Cholecystectomy	4
Other gastrointestinal procedure	11
Wound debridement	4
Femoral–popliteal artery bypass	3
Tracheostomy	2
Skin graft	2
Other	10
Urgency of surgical procedure	
Elective	11
Urgent	90
Emergent	15

years, with a median age of 92 years. Thirty-two patients were aged 95 years or older and 92 were women. Seventy-five of the patients were white and 41 were black. Sixty-three patients were admitted from a nursing home, and 77 had a normal or a minimally impaired functional status.

Diagnoses and Procedures

The diagnoses leading to surgery and the surgical procedures performed are listed in Table 2. The most common diagnosis leading to surgery was hip fracture, followed by lower-extremity gangrene and small bowel obstruction. Nine patients underwent surgery for cancer, including two patients with colon cancer and one each with cancer of the pancreas, breast, esophagus, ovary, lung, skin, and prostate. The surgical procedures were most often classified as urgent.

Mortality

Nineteen of the patients died in the hospital between the 1st and 62nd postoperative day (Table 3). Primary causes of the in-hospital deaths were cardiac in nine patients (six cardiac arrests not further classified, one acute myocardial infarction, one arrhythmia, and one congestive heart failure); sepsis in four (two perforated sigmoid colons, one pneumonia, and one sepsis from infected pressure sores); adult respiratory distress syndrome in one; renal failure in one; and gastrointestinal hemorrhage in one. The cause of death is unknown for three patients.

Table 3. Causes of In-Hospital Mortality Among 19 Nonagenarians Who Underwent Surgery

Cause	No.
Cardiac arrest (not further specified)	6
Sepsis from perforated sigmoid colon	2
Acute myocardial infarction	1
Arrhythmia	1
Congestive heart failure	1
Pneumonia	1
Sepsis due to infected pressure sores	1
Adult respiratory distress syndrome	1
Renal failure	1
Gastrointestinal hemorrhage	1
Unknown (patient found dead in the bed)	3

The perioperative mortality rate, which includes all deaths within 30 days of surgery plus all deaths during hospitalization, was 19.8% (23 of 116). There was a higher perioperative mortality rate for patients undergoing abdominal procedures (33.3%, 8 of 24) as compared with patients undergoing surgery for hip fracture (16.7%, 9 of 54) and lower-extremity amputation (11.8%, 2 of 17); however, these differences did not reach statistical significance (P=NS, χ^2 test).

Ninety-seven patients survived long enough to be discharged from the hospital. One patient was lost to follow-up. At 7 years, the remaining 115 had been either confirmed as alive by direct telephone interview or confirmed as dead by having a death certificate on file with the Georgia Office of Vital Statistics. Long-term survival in this group of patients is shown in Figures 1 through 3. At the final follow-up, after 7 or more years, only three of the 116 patients were still living. Expected survival of an age-, race-, and sex-matched cohort of the general US population was significantly better than that of the patients who underwent surgery (P<.001, logrank test). The average life expectancy of our cohort after surgery was 1.78 years, compared with 4.1 years for the age-matched general US population (US Decennial Life Tables).[3] There was a steep decline in survival until about 6 months after surgery, after which the mortality rate of the survivors of surgery was similar to that of the matched general population group. We have no data on causes of death for patients who died after hospital discharge.

The postoperative survival rate of patients admitted from nursing homes (median years of survival, 0.7) was significantly worse than that of patients admitted from a family residence (median years of survival 1.59; P=.04).

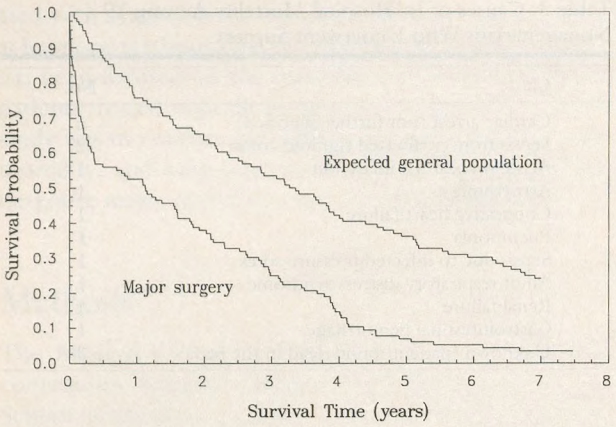

Figure 1. Expected survival among the general population of nonagenarians as compared with the survival rate of 116 nonagenarians who underwent major surgery.

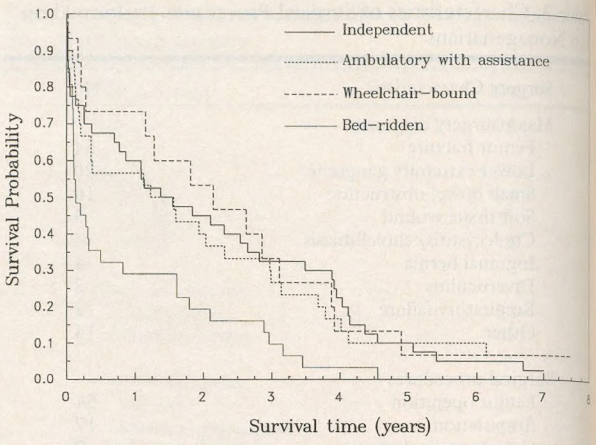

Figure 3. Postsurgical survival outcomes for 116 nonagenarians at various levels of ambulatory status.

Patients with minimal or no functional impairment before hospitalization survived longer than those with severe or complete functional impairment (P=.004). At 1 year of follow-up, 60% of patients with minimal or no impairment were still alive, compared with 38% of patients with major or complete functional impairment before operation (Figure 2). Bedridden patients had a particularly poor survival rate after major surgery, with 68% dying within 6 months of surgery. There were no significant differences among the other three categories of ambulatory status, all three having better survival rates than the bedridden patients (P=.006, Figure 3). There were no significant differences in long-term survival by age, sex, race, major diagnosis, or surgical status (emergency, urgent, or elective).

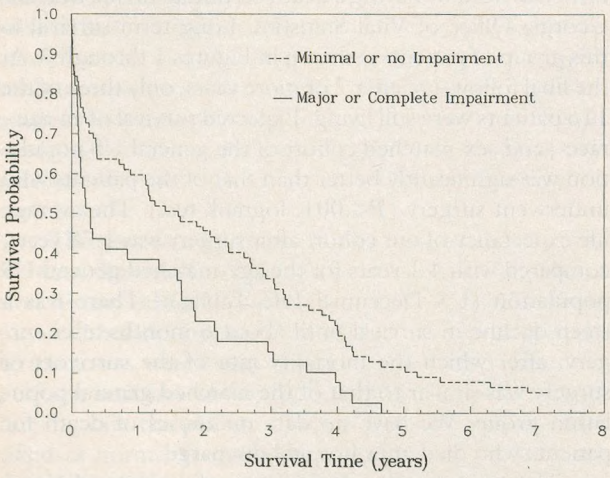

Figure 2. Postsurgical survival rates among nonagenarians who were either not impaired or minimally impaired before surgery, compared with that of nonagenarians who were severely or completely impaired before surgery (N=116).

Hospital Complications

In addition to the 19 hospital deaths, 21 patients suffered 30 nonfatal complications while still in the hospital. These included urinary tract infection (9), heart failure (3), electrolyte imbalance (3), arrhythmia (2), ileus (2), pulmonary embolus (2), urinary retention (2), and 1 each for stroke, pneumonia, pleural effusion, and respiratory failure. Only 3 patients developed wound complications: 1 hematoma and 2 wound dehiscences.

Discharge Characteristics

Ninety-seven patients survived hospitalization. At discharge, all 52 surviving patients admitted from nursing homes returned to nursing homes. Of the 45 surviving patients admitted from family homes, 13 were discharged to nursing homes; the remainder returned to family homes.

Of the 97 patients surviving to hospital discharge, only 5 of the 25 patients who had been independently ambulatory before admission remained ambulatory at discharge, most of whom were in the immediate recovery period following hip surgery and were ambulatory with assistance at discharge. Of the 56 surviving patients who were preoperatively ambulatory (25 independently ambulatory; 31 ambulatory with assistance), 13 completely lost this ability: after surgery, 11 were confined to wheelchairs and 2 were bedridden. Four patients improved in ambulatory status from admission to discharge.

Functional status did not improve for any patient

from admission to discharge. Of the 97 survivors, 84 maintained the same functional status, while 13 declined.

Discussion

Available data on the results of surgery in very old patients are mostly limited to retrospective case series, usually without long-term survival information. Experience in operating on elderly patients was reported in the 1960s and 1970s, with 30-day mortalities ranging from 6% to 24%.[7-9] With improvement in anesthetic and surgical techniques, perioperative mortality rates of elderly patients are generally thought to have decreased over the last three decades.[10] Case series of older patients undergoing neurosurgery,[11] cardiac surgery,[12,13] breast cancer procedures,[14,15] thoracotomies,[16] various cancer operations,[10] and surgery for trauma[17,18] have been reported. Schöön and Arvidsson[19] found a perioperative mortality rate of 10.8% and a 1-year mortality rate of 26.0% in 528 patients who were older than age 80 and admitted in 1987 to a Swedish hospital for surgical illnesses.

The results of most series suggest that surgical disease in the elderly should be treated aggressively because of the increased complication and mortality rates associated with treatment delays.[20] Linn et al,[21] however, reported rising surgical mortality rates among older adults, probably related to a more aggressive surgical approach to severely ill elderly patients who previously have been managed nonsurgically.

Few series of surgical patients in their 90s have been published. In a study of 301 procedures performed on patients over 90 years of age, Denney and Denson[22] reported a 29% overall postoperative mortality rate, with a 63% mortality rate for patients with bowel obstruction. In 85 nonagenarians, Adkins and Scott[23] found that the 30-day mortality rate was only 2.3% for elective surgery vs 43% for emergency procedures. Cohen and colleagues[24] reported on 46 nonagenarians who were followed for 2 years after undergoing major surgery. The operative mortality rate was 20%, but 67% were alive at the end of 2 years. In our series, 90.5% of surgical procedures were either emergent or urgent. The 20% perioperative mortality rate in our series is comparable to those reported in the other studies cited.

A unique cohort of nursing home patients who underwent major surgery was examined by Keating.[25] Of 80 nursing home patients (median age, 86 years) who underwent surgery, 3 died in the hospital and 34 experienced serious complications. Surgical procedures in centenarians are described in two small case series.[26,27]

The most comprehensive analysis of nonagenarians undergoing surgery has been provided by Warner and Hosking and their several colleagues.[28-31] These authors have detailed the results of 1063 procedures in 795 patients who were 90 years or older when treated at the Mayo Clinic. Early and long-term mortality rates were extremely low: 1.6% had died at 48 hours, 8.4% at 30 days, 31.4% at 1 year, and 78.8% at 5 years. The long-term survival rate of the surgical patients, 21.2% at 5 years, was significantly better than that estimated for an age- and sex-matched cohort of nonagenarians. The patients in our series demonstrated considerably higher mortality rates both in the perioperative period (20%) and for the first year following surgery (47%) than those reported from the Mayo Clinic. At 5 years of follow-up, only 6.5% of the patients in our study were alive.

The differences in these mortality rates may be explained by differences in the study populations. Operations for fractured hip and lower-extremity amputations were the most common procedures in the Mayo Clinic series, but patients undergoing ophthalmologic procedures and surgery under local anesthesia were included as well. In our series, only the results of major surgical procedures were evaluated; lower risk procedures, such as endoscopy or those requiring only local anesthesia, were excluded. Moreover, 90.5% of surgical procedures in our series were either emergent or urgent. In the Mayo series, only 15.0% of operations were emergent, with the balance classified as elective.

It may be that extremely old patients who are referred to a tertiary care medical center for surgery represent a robust subset of all 90-year-olds who are seen with surgical illness. Frail elderly patients who need urgent or emergent surgery may be more likely to be managed at the community hospital level. Our series presents the experience of a large community hospital in the southeastern United States. Many of the patients in our study had extremely poor functional status: 63 were nursing home residents, 39 had major functional impairments, and 30 were bedridden (Table 1). Surgery in patients who had major functional impairments and had been admitted from nursing homes had a shorter average life expectancy (1.01 years) than did those who did not have functional impairments and were living in a family residence (2.47 years).

Remarkably, Hosking and co-workers[28-31] found that surgical patients' long-term survival was significantly better than that estimated for an age- and sex-matched cohort of nonagenarians. Andersen and Ostberg[32,33] reported that the survival of elderly patients undergoing surgery in Denmark was also better than that of the general Danish population. Our patients' survival rate was clearly worse than that of the age-, race-, and sex-matched population. By 1 year postoperatively, however, the survival curve for all patients in the present study assumed the

steady decline characteristic of the general age-, sex-, and race-matched population (Figure 1). This similarity suggests that although surgical illness and surgery are responsible for many deaths, once the patient survives this postoperative period, he or she is subject to a mortality rate much like that of the general population.

The number of nonagenarians admitted to our hospital with surgical problems who were not considered appropriate candidates for operative treatment is not known. To our knowledge, an analysis of elderly patients with surgical problems who were not offered an operation has not been reported. Such an analysis might allow comparisons of practice patterns and improve our ability to select elderly patients who would most benefit from surgery. For a number of illnesses that afflict the very old, there are accepted surgical treatments; but surgical complications are more common among this age group than in the young; there is less room for minor technical error; and there is often a lack of specific outcome data regarding surgical procedures.[32]

Our study is limited by being a retrospective chart review. We also did not use standardized and detailed evaluations of functional status, but rather a global measure derived mostly from chart review. The accuracy of this functional information is obviously less precise than that obtained by standardized tests of function. Because we do not have any long-term functional information, it is likely that some patients recovering from hip fracture, for example, may have improved in functional and ambulatory abilities after rehabilitation.

The medical literature demonstrates that even patients of extremely old age can tolerate lifesaving procedures, such as cholecystectomy and repair of femoral fractures. Function can often be maintained or enhanced in selected patients.[34] The present case series confirms that indicators of the quality of life, such as functional status and ambulatory ability, are important predictors of long-term outcome in very elderly surgical patients. For example, in patients admitted from family homes who had no functional deficits and were previously ambulatory (independently or with assistance), the 1-year survival rate was 63%, compared with 34% for nursing home patients with either severe functional deficits or inability to ambulate. Chronologic age should not be used as the sole criterion for determining the appropriateness of surgical intervention.

We believe that clinicians should be extremely cautious in recommending major surgery to patients over age 90. Our case series probably represents a selected, robust group. It is likely that many nonagenarians with surgical illnesses were never admitted to the hospital, or if admitted, were not considered for surgery. Patients with extremely poor functional status, for example, those who are bedridden and dependent in all activities of daily living, are unlikely to obtain functional improvement from surgery. For some patients with advanced dementing illnesses, it may be more humane and compassionate to provide comfort measures as an alternative to complex surgical procedures.

The relationship between the primary care physician and the consultant surgeon is also of practical importance. A request for surgical consultation implies to some degree that an operation is a serious consideration. The surgeon may feel that the requested consultation is essentially a request for confirmation of the appropriateness of surgery. As a result, the consultant may have difficulty recommending a nonsurgical management scheme that may conflict with the primary care physician's impression and the family's expectations. Close cooperation and open communication among the primary care physician, consultant surgeon, family, and patient are essential.

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