



Original article

Impact of age on postoperative outcomes in 1118 gastric cancer patients undergoing surgical treatment

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Abstract

Background. The purpose of the study was to evaluate the impact of age on outcomes in gastric cancer surgery.

Methods. Patients on the hospital database who underwent gastric resection for gastric cancer during the period 1990–2005 ($n = 1118$) were divided into two groups: group A, patients 75 years or older ($n = 249$), and group B, those younger than 75 years ($n = 869$).

Results. Overall preoperative complications were diagnosed in 92 (37%) patients of group A, compared with 147 (17%) in group B ($P = 0.002$). Fifty-five percent of patients underwent resection with D2 or more lymph node dissection (37% [$n = 93$] in group A, and 60% [$n = 521$] in group B; $P = 0.003$). Postoperative overall morbidity was higher in the elderly group (29% in group A versus 23% in group B), but the difference between the two groups was not significant ($P = NS$). Overall postoperative surgical complications were recorded in 201 (18%) patients; 49 (20%) in the elderly cohort, compared with 147 (17%) in the younger group ($P = NS$). The postoperative mortality rate was 3% ($n = 7$) in the elderly group, compared with 3% ($n = 26$) in the younger cohort ($P = NS$). Multivariate Cox analysis showed that age was not an independent risk factor for postoperative morbidity and mortality. Overall 5-year survival was 47% in group A and 54% in group B ($P = NS$).

Conclusion. Due to improved perioperative management, resection of gastric carcinoma is the treatment of choice in elderly patients. Although comorbidities were more frequent among the elderly patients, postoperative morbidity and mortality, even after extensive resections, was low. Survival rates were comparable to those in the younger patients.

Key words Gastric cancer · Elderly · Gastric resection

Introduction

Gastric cancer is one of the most frequent tumors in the world. In recent decades, the incidence has declined, but the prognosis in Western countries has not improved, the 5-year survival being 20%–40%. The curative treatment of stomach adenocarcinoma requires gastric resection [1]. In many previously reported series, almost 60% of surgically treated patients had pathological tumor (pT) stages 3 and 4 [2]. The prognosis is generally poor, and even after potentially curative gastric resections, disease recurrence develops in at least 80% of patients [3]. A surgical approach of potentially curable gastric cancer, including extended lymphadenectomy, seems to give better results when compared with less radical procedures [4]. Although gastric cancer mortality has decreased significantly in many industrialized nations, it remains one of the most common causes of cancer-related deaths in the world. Screening programs are not usually performed due to their high cost and minimal benefit in decreasing mortality rates [5]. Surgical resection is the most powerful tool to improve prognosis, but the major problem is delayed diagnosis, resulting in advanced disease. The world population is ageing. Since gastric cancer is usually diagnosed as advanced disease and is associated with poor prognosis, some physicians favor palliative approaches over radical resection in elderly patients. Despite a decrease in the incidence of gastric cancer, the number of patients aged 75 years and older (elderly patients) with this disease is increasing [6]. At a higher age, comorbidity is more common, which, it seems, is reflected by higher postoperative mortality. For aged patients in particular, the benefits of surgical treatment have to be balanced against postoperative morbidity and mortality, and to elucidate this balance of benefits, there is a need for information on prognostic factors and contemporary results. Historically, it has been suggested that elderly patients do not fare well after surgery for gastric cancer,

with high rates of inoperability and perioperative mortality [7]. Due to the high rate of morbidity and mortality in elderly patients, minimally invasive surgery may have a larger impact on elderly than on younger populations, in terms of fewer cardiorespiratory complications, shorter hospital stay, and more rapid return to physical activities [8–10]. The purpose of this study was to evaluate the impact of age on gastric cancer presentation, surgical management, and outcomes in 1118 patients who underwent gastric resection for cancer at a single Western institute.

Patients and methods

Data of all patients surgically treated for gastric cancer at the San Raffaele Scientific Institute during the period 1990–2005 ($n = 1118$) were retrospectively collected. Data included: age, sex, size and location of the tumor, and TNM stage (Table 1). Tumor stage was registered according to the TNM criteria [11]. Postoperative mortality was defined as death occurring within the first 30 days after operation. Statistical analysis was carried out using the Statistical Package for the Social Sciences (SPSS 11.0; Chicago, IL, USA). The values for results were expressed as means \pm SD. Overall survival was established from the date of surgery to death from any cause or the date of the last follow-up visit. Overall survival was calculated according to the Kaplan-Meier method. The log-rank test was used to compare survival data between groups. Frequencies were compared by Pearson's χ^2 method. Continuous variables were analyzed parametrically, using the t -test. Multivariate analysis was performed using the Cox proportional hazards model. The length of follow-up was described as the mean value, with 95% confidence limits.

Results

Over the 15-year period, 1118 patients with gastric cancer were surgically treated. They were divided on the basis of age into two groups: group A, with 249 patients (22%) aged 75 years or older, and group B, with 869 patients (78%), under 75 years of age. The mean age of group A was 80.6 ± 3.7 years, and that of group B was 61.5 ± 10.3 years (Fig. 1A,B; $P < 0.0001$). There was a significant difference between the groups in the sex ratio (group A, 120 men and 129 women; group B, 538 men and 331 women). The locations of the tumors (proximal, middle, and distal stomach) were similar in the two groups. There were no differences between the two groups in respect to tumor stage (Table 1). Overall preoperative complications were diagnosed in 92 (37%) patients in group A, compared with 147 (17%) in group B ($P = 0.002$), the commonest being gastrointestinal bleeding (group A, 54 [22%]; group B, 70 [8%]; $P = 0.001$). Comorbidities were more frequent among the elderly patients, with more patients of group A classified as having an ASA score of 3–5 ($P = 0.0002$). Emergency surgery (mainly because of stenosis, perforation, or gastrointestinal bleeding) was performed in 56 (5%) patients, with no difference between the two groups. There were no differences in inclusion criteria for gastric surgery between the two groups. Preoperative evaluation of organ function had been done in all patients. Patients with an ASA score of 4 or more had been excluded from having surgical treatment with curative intention, except for emergency cases in which the surgical indication was bleeding, perforation, or stenosis. There were differences between the two groups with regard to the type of operation, with a higher number of total resections in group B (Table 2; $P < 0.001$). The extent of lymph node dissection was modified during the study period; in the more recent years, patients in the younger

Table 1. Characteristics of gastric cancer in 1118 patients who underwent surgical treatment

Patient group	Group A (>75 years; $n = 249$)	Group B (≤ 75 years; $n = 869$)	P value
Men: Women (percentage of men)	120:129 (48)	538:331 (62)	<0.001
Tumor location			NS
Upper third	38 (15)	139 (16)	
Middle third	82 (33)	286 (33)	
Lower third	129 (52)	444 (51)	
Early vs advanced cancers	40/249 (16)	182/829 (22)	0.057
Cancer ≥ 5 cm	114/249 (46)	304/869 (35)	0.04
Lymph node metastasis	187/249 (75)	626/869 (72)	NS
Tumor stage (TNM)			NS
Stage I-II	136/249 (55)	443/869 (51)	
Stage III-IV	113/249 (45)	426/869 (49)	

Values are numbers, with percentages in parentheses

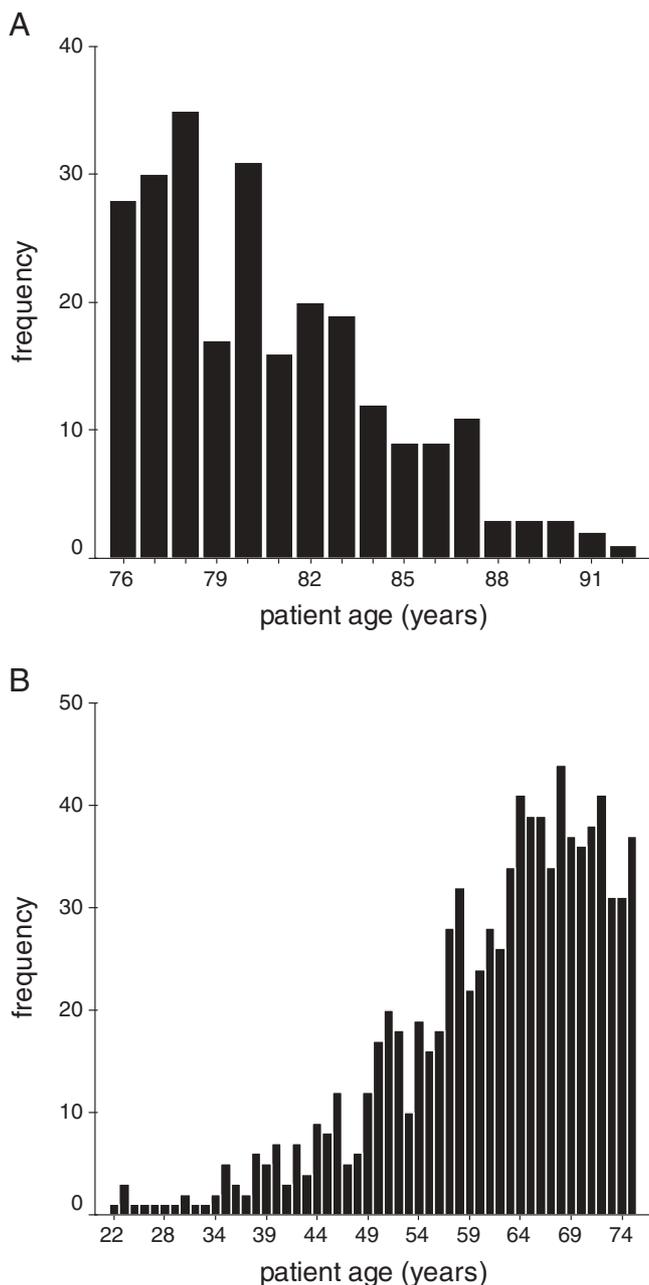


Fig. 1A,B. Age trends in patients who underwent gastric resection for cancer; **A** patients older than 75 years; **B** patients younger than 75 years

group were candidates for D2 lymphadenectomy and the elderly were candidates for D1. D2 lymphadenectomy was defined according to the rules of the Japanese Research Society for Gastric Cancer and, therefore, included all lymph nodes of levels N1 and N2 (Table 2). Fifty-five percent of patients underwent resection with D2 or more lymph node dissection (37% [$n = 93$] in group A, and 60% [$n = 521$] in group B; $P = 0.003$). The overall resection rate was 92% (93% in group A and 91% in group B). Minimally invasive techniques were

applied in 108 patients (10%). Of the 249 patients in the group aged 75 years or older, 231 patients (93%) underwent curative resection, and 18 patients (7%) underwent palliative surgery. The operative curability was similar ($P = NS$). Postoperative overall morbidity was higher in the elderly group (29% in group A versus 23% in group B), but the difference between the two groups was not significant ($P = NS$). The postoperative morbidity rate was similar in groups A and B, whether the surgical indication was emergency or elective surgery. Overall postoperative surgical complications were recorded in 201 (18%) patients; 49 (20%) in the elderly cohort, compared with 147 (17%) in the younger group ($P = NS$). The rate of nonsurgically related complications was similar in the two groups (15% [$n = 37$] and 11% [$n = 95$] in groups A and B, respectively; $P = NS$). The overall rate of anastomotic leakage was 7% ($n = 75$), with rates of 9% ($n = 23$) and 6% ($n = 52$) in groups A and B, respectively ($P = NS$). The postoperative mortality rate was 3% ($n = 7$) in the elderly group, compared with 3% ($n = 26$) in the younger cohort ($P = NS$). The postoperative mortality rate was similar in groups A and B, whether the surgical indication was emergency or elective surgery. The influence of age, sex, location of the tumor, TNM stage, ASA score distribution, emergency operation, type of surgery (laparoscopy versus laparotomy), group A versus group B, number of positive lymph nodes, and tumor size on postoperative mortality was evaluated using multivariate Cox analysis (Table 3). TNM stage and the number of positive lymph nodes were found to be independent risk factors for postoperative mortality in this analysis. The influence of age, sex, location of the tumor, TNM stage, ASA score distribution, emergency operation, type of surgery (laparoscopy versus laparotomy), group A versus group B, number of positive lymph nodes, and tumor size on postoperative morbidity was also evaluated using multivariate Cox analysis (Table 4). TNM stage was found to be an independent risk factor for postoperative morbidity in this analysis. The mean diameter of the tumors was 5.2 ± 2.9 cm (minimum, 0; maximum 16 cm) in group A and 4.7 ± 2.8 cm (minimum, 0 and maximum, 15 cm) in group B ($P = NS$). The pathologic characteristics were similar in patients aged less than 75 years and those aged 75 years or more. The rate of lymph node metastasis was similar in the two groups (75% [$n = 187$] in group A and 72% [$n = 625$] in group B; $P = NS$). As shown in Fig. 2, the mean number of lymph nodes retrieved was higher in group B (20 ± 13) than in group A (17 ± 12 ; $P = 0.002$). The mean number of lymph node metastases was similar in the two groups (6 ± 9 versus 5 ± 7 in group A and group B, respectively; $P = NS$; Fig. 3). The mean length of hospital stay was also similar in the two groups (15 ± 14 days and 13 ± 13 days in group A and group B, respectively; $P = NS$). The mean length

Table 2. Treatment modalities (gastric cancer patients; $n = 1118$)

Patient group	Group A (>75 years; $n = 249$)	Group B (≤ 75 years; $n = 869$)	P value
Operative approach			<0.001
Subtotal gastrectomy	202 (81)	617 (71)	
Total gastrectomy	47 (19)	252 (29)	
Type of surgery			NS
Laparoscopic surgery	24/249 (10)	84/869 (10)	
Open surgery	225/249 (90)	785/869 (90)	
Extent of lymphadenectomy			0.003
D1	156 (63)	348 (40)	
D2	93 (37)	521 (60)	

Values are numbers, with percentages in parentheses

Table 3. Multivariate analysis (Cox regression) of factors influencing survival of 1118 gastric cancer patients undergoing surgical treatment

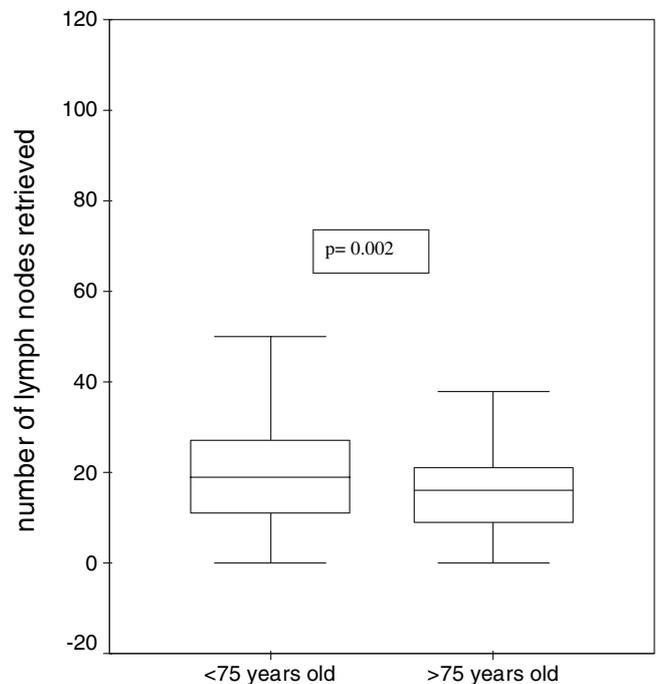
	P
ASA score	0.079
Surgical indication (emergency or elective surgery)	0.989
Sex	0.083
Age	0.375
Type of operation (laparoscopy vs laparotomy)	0.142
TNM stage	0.012
Tumor location (proximal, middle, distal)	0.668
Group A > 75 years vs group B < 75 years	0.928
Tumor size	0.432
Number of positive lymph nodes	0.050

ASA, American Society of Anesthesiologists

Table 4. Multivariate analysis (Cox regression) of factors influencing morbidity in 1118 gastric cancer patients undergoing surgical treatment

	P
ASA score	0.162
Surgical indication (emergency or elective surgery)	0.057
Sex	0.219
Age	0.826
Type of operation (laparoscopy vs laparotomy)	0.06
TNM stage	0.027
Tumor location (proximal, middle, distal)	0.790
Group A > 75 years vs group B < 75 years	0.779
Tumor size	0.576
Number of positive lymph nodes	0.219

of follow-up was 39 months. Overall 5-year survival was 47% in group A and 54% in group B ($P = \text{NS}$; Fig. 4), while the overall 5-year survival in patients with metastatic lymph nodes in groups A and B, respectively, was 37% and 39% ($P = \text{NS}$).

**Fig. 2.** Mean number of lymph nodes retrieved in 1118 patients who underwent gastric resection for cancer (group A, patients older than 75 years [$n = 249$]; group B, patients younger than 75 years; [$n = 869$]). Boxes extend from the 25th to the 75th percentile and contain the middle half of the scores in the distribution; bars indicate median values; whiskers indicate minimum and maximum values

Discussion

The incidence of gastric cancer has been steadily declining since the early part of the twentieth century. Nevertheless, due to increased life expectancy, the numbers of elderly patients suffering from gastric carcinoma are continuously rising. No standard definition of “elderly” exists, with different authors using thresholds of 65, 70, 75, 80, and 85 years [12–14]. Data from the Italian Office

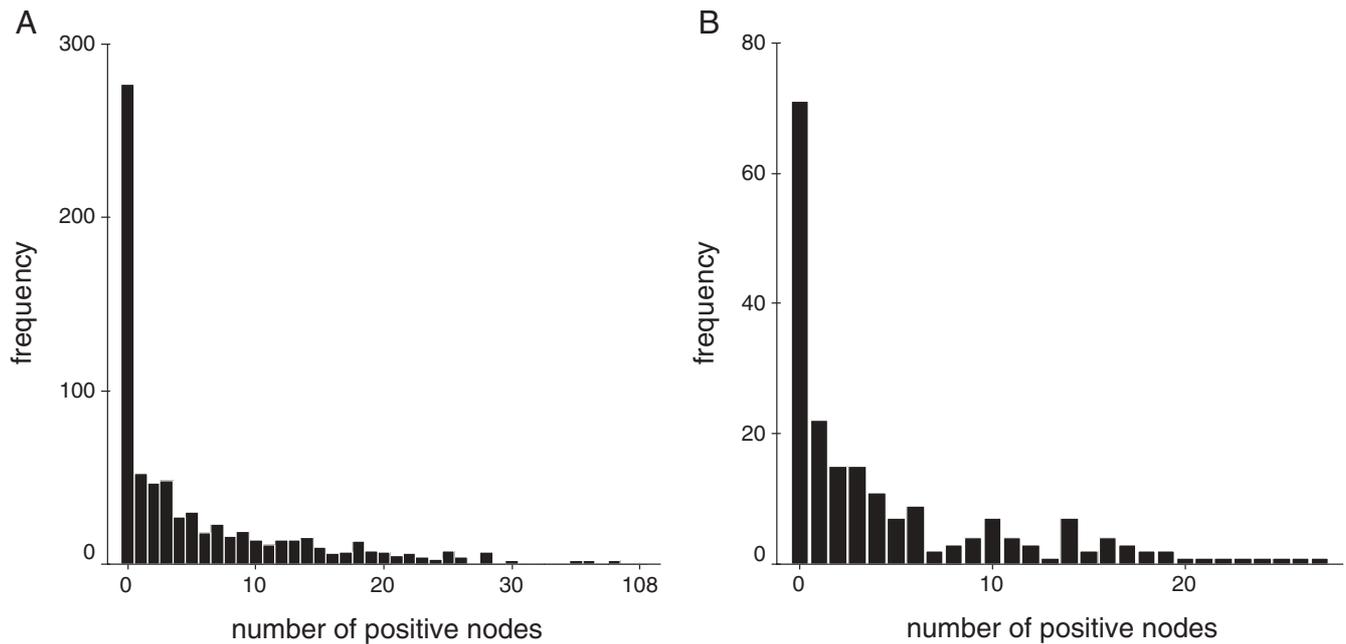


Fig. 3A,B. Numbers of lymph node metastases in 1118 patients who underwent gastric resection for cancer. **A** Patients younger than 75 years (group B; $n = 869$); **B** patients older than 75 years (group A; $n = 249$). P , not significant (NS)

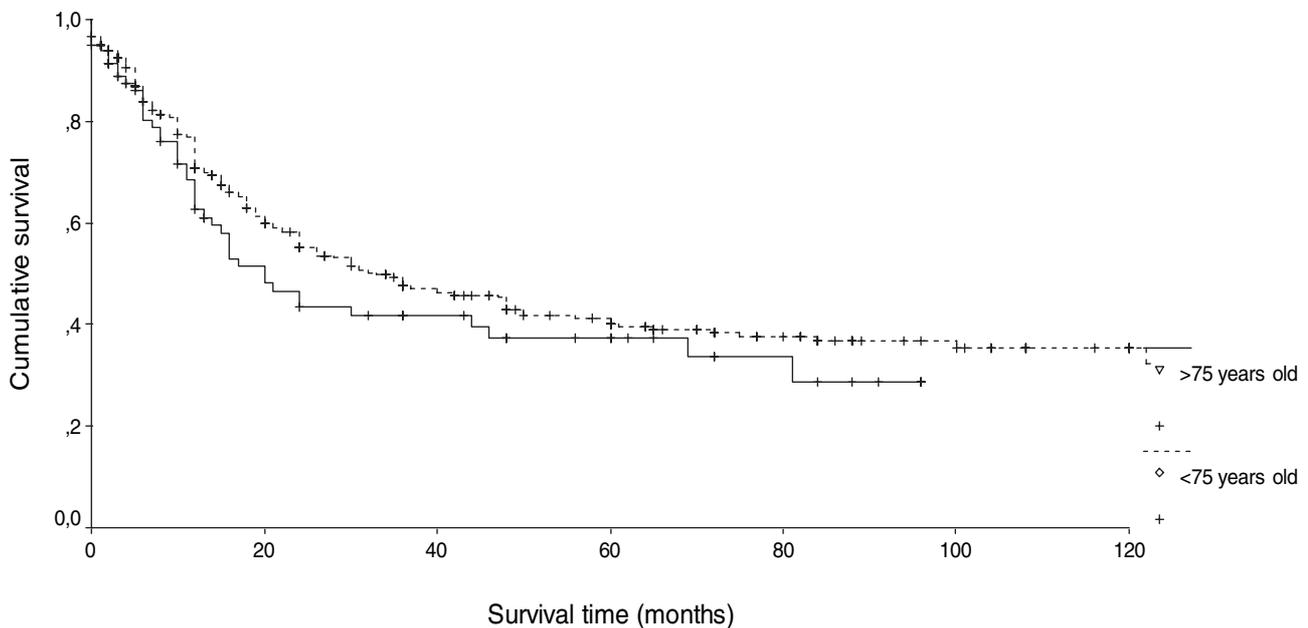


Fig. 4. Survival in the 1118 patients who underwent gastric resection for cancer. Group A, patients older than 75 years ($n = 249$); group B, patients younger than 75 years ($n = 869$). Kaplan-Meier analysis. Log-rank test ($P = NS$)

of National Statistics show that average life expectancy in Italy is 77 years; 74 years for men, and 80 years for women. We selected 75 years as the threshold for “elderly”, because it is quite similar to Italian median life expectancy. “Biological” age varies in different nationalities and populations, and it is reasonable that a 75-year-old Italian is equivalent to an 85-year-old Japanese,

due to the differing life expectancies of these populations, although more detailed demographic assessments would be necessary to validate such assumptions. In aged patients, the preoperative surgical risk is often high, as has been reported previously. Postoperative morbidity and mortality is a significant source of concern in the management of elderly patients with gastric

cancer [12–16]. Our study has confirmed that the majority of complications arising in the surgical management of elderly patients with gastric cancer are not truly surgical, but are of a more general nature, both pre- and postoperatively, the latter perhaps compounded by less than optimal preoperative preparation. Resection rates for elderly patients are usually slightly lower than those in younger patients, due to preoperative complications and comorbidities. Nevertheless, our data confirm that advances made in surgical techniques, and in anesthetic and postoperative intensive care, have resulted in an increase in the possibility of performing curative resections in 93% of patients aged 75 years or older. Postoperative morbidity in our younger and elderly groups was similar, with specific surgical and nonsurgical postoperative complications occurring at no greater frequency in the elderly than in the younger patients. Overall mortality was 3% in the elderly group, compared with 3% in those under 75 years old ($P = \text{NS}$). Overall survival was, surprisingly, similar in the elderly when compared with the younger group. Due to improved perioperative management, resection of gastric carcinoma is the treatment of choice in elderly patients [17]. Although comorbidities were more frequent among the elderly patients, postoperative morbidity and mortality, even after extensive resections, was low. The evaluation of gastric cancer surgery in this study shows that curative resection can be performed for elderly patients with an acceptable mortality rate, possible long-term survival, and good results.

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