response to therapy. Reflecting the fact that no complete remission was achieved, S100 remained detectable in all patients.

Previously, serum NSE was proposed as a prognostic factor in metastatic melanoma [4, 5]. In this study, the relationship between serum S100 and NSE in patients with malignant melanoma was investigated. In agreement with previously published data, in some patients serum NSE seemed to be a useful tumour marker for the monitoring of the efficacy of treatment and the progression of the disease. Nevertheless, its diagnostic sensitivity (23.9%) for patients with clinical stage III/IV versus patients with clinical stage I/II is lower than that of serum S100 (sensitivity 41.3%; $P < 0.05$). Serum S100 showed a better discrimination between patients with distant metastases (stage IV) and those without it. In each of the 6 patients in whom serum S100 and NSE were measured serially, serum S100 concentrations were above the cut-off value and reflected progression or remission of the disease, whereas in 2 of these patients NSE concentrations remained below the cut-off value. In the other 4 patients, serum S100 and NSE were correlated.

In conclusion, the current study supports the clinical significance of serum S100 in metastatic malignant melanoma. Serum S100 showed a higher sensitivity than serum NSE and correlated with the clinical stage of the tumour. Serial measurements of S100 were helpful in monitoring the treatment.

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The Influence of Age on Resection Rates and Postoperative Mortality in 2773 Patients With Gastric Cancer

R.A.M. Damhuis and H.W. Tilanus

Resection rates and postoperative mortality rates were studied in patients with gastric cancer, diagnosed from 1982 until 1992 in the southwestern area of the Netherlands. Overall, 51% of the patients underwent resection. For patients aged 0–59, 60–69, 70–79 and 80 years and over, resection rates were 64, 55, 54 and 35%, respectively. Tumours located in the cardia were less often resected than tumours of the antrum, 39 versus 71%. The postoperative mortality after resectional operations was 8.3%; 9.2% for men and 6.7% for women. The operative risk increased markedly after the age of 70 years; for patients under 70 years of age, the rate was 3.4% compared with 12.4% for those aged 70 years and older. These results indicate that elderly patients can be operated on at an acceptable risk, and that palliative resections may be considered, especially in patients younger than 70 years.

Key words: stomach cancer, gastrectomy, postoperative mortality, aged

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INTRODUCTION

SURGICAL RESECTION is currently the only treatment that may offer cure for patients with gastric cancer, although results have not been encouraging. In 1989, a British study reviewed treatment and survival of 31716 patients, diagnosed between 1957 and 1981, and reported rather poor results [1]. Only 29% of patients were treated by resection, surgical mortality was 19%, and 5-year survival was 20% after curative resections and 5% overall.

Since then, results have improved. Postoperative mortality rates have declined in recent decades [2], whereas resection and survival rates have increased, possibly due to earlier detection [3]. These trends have occurred in spite of the increasing age of patients with gastric cancer, caused by the ageing of the general population. At higher age, comorbidity is more common, which is reflected by higher postoperative mortality [4] and lower resection rates [5]. For elderly patients in particular, the benefits of surgery have to be balanced against postoperative morbidity and mortality, which illustrates the need for information on prognostic factors and contemporary results.

We evaluated resection rates and postoperative mortality in patients with gastric cancer, diagnosed from 1982 until 1992 in the southwestern area of the Netherlands. The purpose of this study was to assess the impact of age, gender, site and stage on operative risk in order to facilitate decisions regarding treatment choice in individual patients.

PATIENTS AND METHODS

Information on all registered patients diagnosed with gastric cancer between January 1982 and December 1992 was derived from the Rotterdam Cancer Registry. This registry started in 1982 in three hospitals and gradually expanded until 1989, when full coverage of the southwestern area of the Netherlands was achieved, an area with 22 hospitals and 2.2 million inhabitants. Newly diagnosed cancer patients were notified to the registry through notes from pathology departments and hospital discharge diagnoses. After notification, trained registrars collected data from the clinical records. These records were examined at least 3 months after diagnosis, thus enabling a limited follow-up. Tumour site and morphology were classified according to the rules of the International Classification of Diseases for Oncology (ICD-O). Tumour stage was registered according to the TNM regulations [6, 7]. With respect to treatment, resectional operations were coded without distinguishing the different forms of resection.

For various reasons, 171 patients were excluded from the analyses (27 carcinoma *in situ*, 124 lymphomas, 19 sarcomas, one metachronous tumour). For the purpose of tabulation, TNM categories were grouped together [7]; ICD-O subsites were combined according to the scheme presented in Table 1. Postoperative mortality was defined as death within 30 days after resectional operation. 19 patients who received preoperative radiotherapy were included for the analysis of resection rates but excluded from the analysis of postoperative mortality, to avoid confounding by downstaging.

Resection rates and postoperative mortality rates were tabulated and analysed using multivariate logistic regression. The categories of the variables were represented by indicator variables, and their predictive value was assessed with the P value of the log likelihood. Only variables significantly improving the fit of the model ($P < 0.05$) were included in the final model. Odds ratios were calculated together with 95% confidence intervals and represent the relative risk as compared to the reference category. Tabulations were evaluated by the χ^2 test.

RESULTS

The study population comprised 2773 patients, 1819 men and 954 women (Table 1). The median age at diagnosis was 73 years, and 27% of patients were 80 years or older. Almost 25% of tumours were located in the cardia, which was similar to the proportion in the antrum and pylorus. Twenty-two per cent were located at intermediate single sites while 16% were diagnosed at overlapping subsites. In 13% of cases, subsite was unknown or not specified.

The resection rate was 51% overall and decreased significantly with age. Of patients aged 80 years or older, only 35% underwent resection. Rates were higher for distal tumours than for proximal lesions, 71 versus 39%, respectively. The larger tumours that were diagnosed at overlapping subsites were resected in only 40% of cases.

The postoperative mortality was 8.3%, and was higher among men than women, 9.2 versus 6.7%, respectively (Table 2). Mortality rates increased greatly after the age of 70; for patients under 70, the rate was 3.4% compared with 12.4% for those aged 70 years and older. According to multivariate analysis, site, year of diagnosis and stage were not significantly related to mortality. Even in patients with stage IV disease, postoperative mortality did not exceed 10%. Age was associated with gender and site in patients who underwent resection (Table 3). Women and distally located tumours were over-represented in patients aged 70 years and over.

DISCUSSION

The surgical treatment of gastric carcinoma has, in terms of perioperative morbidity and mortality, improved considerably in recent decades. In an extensive review, Macintyre reported that surgical mortality had decreased from 16.2% for series closing before 1970 to 13 and 7.8% for those closing before 1980 and 1990, respectively. After exclusion of Japanese series, the mean rate in the last period was 9.3%, which is comparable to the 8.3% we encountered. In Japanese series, mortality rates are generally lower than 5%, but two Japanese studies revealed that the proportion of patients 70 years and over was only 16 and 12%, respectively [8, 9], compared with 55% of patients undergoing gastrectomy in our series. We found a mortality rate of 3% in patients younger than 70 years as opposed to 12% in older patients, which emphasises the importance of reporting results by age category. Recent studies from Germany [10], Finland [11], Sweden [12] and Norway [13] reported rates of 15, 10, 6 and 12%, respectively, for patients aged over 70 years.

Apart from age and gender, no additional risk factors were recognised after multivariate evaluation. In contrast to simple tabulations, multivariate analysis controls for any interactions between the variables. For example, since the median age was higher for women, the prognostic effect of gender turned out to be more pronounced. The male excess risk is probably related to underlying cardiovascular or pulmonary problems, which is reflected by the shorter life expectancy of men in general. The presumed prognostic value of tumour site could not be

Correspondence to R.A.M. Damhuis at the Comprehensive Cancer Center Rotterdam, P.O. Box 289, 3000 AG Rotterdam, The Netherlands.
H.W. Tilanus is at the Department of Surgery, Academic Hospital Dijkzigt, Dr. Molewaterplein 40, 3015 GD Rotterdam, The Netherlands.
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Table 1. Resection rates in 2773 patients with gastric cancer

	n	Resection rate (%)	Odds ratio (95% CI)
Gender			
Male	1819	50	ns
Female	954	52	
Age (years)			
0–59	450	64	1
60–69	626	55	0.67 (0.51–0.86)
70–79	936	54	0.61 (0.48–0.77)
80+	761	35	0.23 (0.18–0.30)
Site			
151.1/2 Antrum and pylorus	686	71	1
151.3/6 Intermediate single sites	618	57	0.44 (0.35–0.56)
151.0 Cardia	689	39	0.20 (0.16–0.26)
151.8 Overlapping subsites	430	40	0.22 (0.17–0.29)
151.9 Not specified/unknown	350	37	0.20 (0.15–0.26)
Year of diagnosis			
1982–1988	1173	51	ns
1989–1992	1600	51	

ns, non-significant.

Table 2. Postoperative mortality in 1391 patients who underwent resection for gastric cancer

	n	Postoperative mortality (%)	Odds ratio (95% CI)
Gender			
Male	900	9.2	1
Female	491	6.7	0.6 (0.4–0.9)
Age (years)			
0–59	282	3.2	1
60–69	340	3.5	1.1 (0.5–2.7)
70–79	500	13.0	4.7 (2.3–9.7)
80+	269	11.2	4.3 (2.0–9.3)
Site			
Distal	488	6.8	ns
Intermediate	350	7.1	
Cardia	256	9.0	
Overlapping	169	11.2	
Not specified	128	12.5	
Stage			
I	382	8.9	ns
II	323	8.0	
III	465	7.5	
IV	176	9.7	
X	45	8.9	
Year of diagnosis			
1982–1988	581	8.1	ns
1989–1992	810	8.5	

ns, non-significant.

confirmed. Previously, a combined analysis of results from 62 European centres showed that surgical mortality was higher for proximal lesions [14]. In our study, the difference was small, but resection rates were lower for cardia tumours, in fact 12% for patients 80 years or older, implying that selection criteria for gastro-oesophageal resection may be stricter. Stage of disease had no prognostic significance, which confirms the findings of the Norwegian study [13].

The resection rates in this study were fairly high, even for patients over 80 years of age. In earlier days, surgical treatment for elderly patients with gastric cancer was debated, mainly due to the high operative mortality and the limited chances for cure. A population-based study from the U.K. [4] reported that only 8% of patients aged over 80 years underwent resection and that 23% of them died within 30 days. The corresponding 35% resection rate and the 11% mortality in our study demonstrate

Table 3. Association between age and other variables in patients who underwent resection for gastric cancer

	Age (years) 0–69 *n* (%)	70+ *n* (%)	*P* value
Gender			
Male	445 (49)	455 (51)	<0.001
Female	177 (36)	314 (64)	
Site			
Distal	181 (37)	307 (63)	<0.001
Intermediate	167 (48)	183 (52)	
Cardia	149 (58)	107 (42)	
Overlapping	70 (41)	99 (59)	
Not specified	55 (43)	73 (57)	
Stage			
I	165 (43)	217 (57)	0.06
II	128 (40)	195 (60)	
III	232 (50)	233 (50)	
IV	76 (43)	100 (57)	
X	21 (47)	24 (53)	
Year of diagnosis			
1982–1988	256 (44)	325 (56)	0.68
1989–1992	366 (45)	444 (55)	

that treatment policy has changed, and that elderly patients can be operated upon at an acceptable risk. Obviously, tumour stage should be taken into consideration but, with the current results, even palliative resections may be considered, especially in patients younger than 70 years.

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