Role of the Extended Lymphadenectomy in Gastric Cancer Surgery: Experience in a Single Institution

Alejandro Sierra, Fernando M. Regueira, José L. Hernández-Lizoáin, Fernando Pardo, Miguel A. Martínez-Gonzalez, and Javier A.-Cienfuegos.

Background: Although curative resection is the treatment of choice for gastric cancer, controversy exists about the adequate extent of lymph node dissection when resection is performed.
Methods: We retrospectively assessed 85 patients who underwent a limited lymphadenectomy (D1) and 71 who had an extended lymph node dissection (D2) in a single institution between 1990 and 1998 (median follow-up, 37.3 months). Prognostic factors were assessed by Cox proportional hazard models adjusted for potential confounders.
Results: We found no significant difference in the length of hospital stay (median, 12.1 and 13.1 days), overall morbidity (48.2% and 53.5%), or operative mortality (2.3% and 0%) between D1 and D2, respectively. Five-year survival in the D2 group was longer (50.6%) than in the D1 group (41.4%) for tumor stages (tumor-node-metastasis) >I. In multivariate analysis, tumor-node-metastasis stage (hazard ratio for stages >I vs. 0–I, 11.6), the ratio between invaded and removed lymph nodes, the presence of distant metastases, Laurén classification, and the extent of lymphadenectomy (hazard ratio for D1 vs. D2, 2.3; 95% confidence interval, 1.25–4.30) were the only significant prognostic factors.
Conclusions: Our experience shows that extended (D2) lymph node dissection improves survival in patients with resected gastric cancer.
Key Words: Extended—Lymphadenectomy—D2—Gastric cancer.

From the General Surgery Department, Clínica Universitaria, University of Navarra (AS, FMR, JLH-L, FP, JA-C), and Epidemiology (MAM-G), School of Medicine, University of Navarra, Pamplona, Spain.
Address correspondence and reprint requests to: A. Sierra, MD, General Surgery Department, Clínica Universitaria, University of Navarra, Avenida Pío XII, No. 36, 31008 Pamplona, Spain; Fax: 34-948 296500; E-mail: asierra@unav.es.

Gastric cancer is the 4th cause of tumoral death in Europe,[1] and it is considered the 10th in the United States. These figures increase 6-fold in Japan, where early detection is becoming increasingly important. Japanese authors[2,3] report survival results significantly better than those in Western series, on the basis of the concept of extended lymphadenectomy (EL).

In 1981, the Japanese Research Society for Gastric Cancer[4] proposed D2 lymphadenectomy as the proper treatment for gastric cancer; this involved radical gastrectomy with level 2 lymph node dissection. Since then, Western groups[5,6] have not reproduced Japanese results in terms of survival and complications. They have found no difference between limited lymphadenectomy and EL, as two large multicenter randomized studies have shown.[7,8] However, these studies had problems of protocol violations (incomplete or more extensive lymph node dissections in the different study groups), a high morbidity/mortality rate because there were a large number of experiences in different hospitals, and, at times, an unnecessary extent of organ resection (that includes the excision of the tail of the pancreas). The aim of this study was to investigate the role of extended (D2) lymph node dissection in a group of patients undergoing surgery in a single institution, thus avoiding the problem of protocol violations associated with multicenter prospective trials.[7–9]

METHODS

We analyzed 156 consecutive patients with resected adenocarcinoma of the stomach operated on between January 1991 and June 1998 in a single institution by three surgeons. We divided patients into two well-balanced groups. The D1 group (85 patients) was submitted to a gastrectomy with N1 level lymph node dissection[4] (major and lesser curvature, supra and subpyloric lymph nodes, and paracardial nodes when total gastrectomy was performed). The D2 group (71 patients) was submitted to a total gastrectomy with EL that included the N1 and N2 lymph node levels (removal of the lymph nodes along the left gastric, common hepatic, and splenic arteries; celiac axis; and splenic hilus), hepatoduodenal ligament (level 12 in the Japanese Research Society for Gastric Cancer classification, including lymph nodes along the portal vein and proper hepatic artery), and sampling of the level N3 and N4 lymph nodes (para-aortic, retropancreatic, and mesenteric nodes).

Although we did not use a randomized design, we did not follow a biased assignment of patients to one or another procedure. Changes in recruitment were due to skepticism about EL results reported in different published series.10–12

We included resectable patients with any tumor stage (1997 tumor-node-metastasis classification[13]), except for those with macroscopic distant metastases (bone, hepatic, lung, or peritoneal) and any location, excluding esophageal tumors, affecting the stomach. Patients with positive peritoneal lavage (two cases in D1 and four cases in D2), affected hepatoduodenal lymph nodes, or localized carcinomatosis at the bursa omentalis (one patient in the D2 group) were also included.

Table 1 shows the characteristics of both groups. They differ only in age (8 years younger in the D2 group), type of gastrectomy (56.5% of patients in the D1 group were submitted to a subtotal gastrectomy vs. none in D2), American Society of Anesthesiologists (ASA) index,[14] and associated radiotherapy. All these features were properly included in a multivariate model to determine their prognostic value and to control for potential confounding.

Splenectomy was performed every time that total gastrectomy was performed, adding distal pancreatectomy, hepatic wedge resection, or partial colectomy only when the surgeon observed macroscopic invasion of these organs. We divided postoperative complications into general (including pleuropulmonary complications [acute lung edema, pleural effusion, atelectasis, pneumothorax, and pneumonia], cardiac complications, phlebitis, sepsis derived from central line infection, and urine infection) and specific (hemorrhage, abscess, fistula, anastomosis dehiscence, esophageal stenosis, incisional hernia, diarrhea, paralytic ileus, dumping, and cholestasis) complications.

The median follow-up was 37.3 months (25th–75th percentile, 16.3–61.5 months), continued until March 2000, and was complete for all the patients in the study. At the end of this study, 39 patients of the D1 group and 25 patients of the D2 group had died. The remaining 92 patients (46 in D1 and 44 in D2) had no evidence of disease.

End Points

Once confirmed that we had two well-balanced groups of patients, one receiving limited lymphadenectomy (D1 operation) and the other an extended lymph node dissection (a modified D2 operation), our purposes were the following.

1. To detect differences in morbidity and hospital mortality between groups.
2. To determine whether one group had a better survival rate.
3. To identify the independent prognostic factors affecting survival, applying a multivariate Cox model.

Statistical Analysis

Analyses were performed with SPSS 9.0 for Windows (SPSS Inc., Chicago, IL). $P < .05$ (two sided) was considered statistically significant. The X^2 test or Fisher's exact test was used to compare qualitative variables. Student's *t*-test (mean and SD) was used for quantitative variables if they were assumed to follow a normal distribution; quantitative nonnormal variables were compared by using the Mann-Whitney *U*-test or the Kruskal-Wallis test. The effect of each prognostic variable was studied in univariate analyses by using the log-rank test; variables with a P value of <.25 were considered candidates to enter a multivariate Cox regression model[15] and were stratified for pathologic tumor stage.

RESULTS

We found no significant difference in overall hospital morbidity (48.2% of patients in D1 and 53.5% in D2; $P = .511$) or length of hospital stay (D1: median, 12.1 days; 25th–75th percentile, 10.0–19.2 days; D2: median, 13.1 days; 25th –75th percentile, 11.0–17.0 days; $P = .306$) between the groups (Table 2). Nevertheless, the durations of surgery (mean: 202.9 minutes in D2 vs. 187.7 minutes in D1; $P = .035$), daily production (161.8 ml in D2 vs. 105.8 ml in D1; $P < .001$), and maintenance of drains (9.9 days in D2 vs. 9.2 days in D1) were longer in the D2 group.

No significant difference was observed in general (14.1% in D1 vs. 8.4% in D2; $P = .269$), nor were there specific complications (34.1% in D1 vs. 45.0% in D2; $P = .162$) between groups (Table 2). Operative mortality (30-day mortality rate) was 2.3% in D1 and 0% in D2 ($P = .295$). Mortality due to causes other than gastric carcinoma (related to radiotherapy or chemotherapy treatment or intercurrent benign or malignant diseases) occurred in eight D1 patients and two D2 patients.

Once specific complications were studied (Table 2), hemorrhage was found in D1 more frequently than in D2 (five patients, due to bleeding through the nasogastric tube at gastroenteroanastomosis). We found that 40% of the D2 patients with a pancreatic fistula underwent an associated distal pancreatectomy.

The median number of dissected lymph nodes was 14.0 in D1 (25th–75th percentile, 8.2–21.0) versus 31.0 in D2 (25th–75th percentile, 24.0–42.0; $P < .001$). The ratio between the number of invaded and resected lymph nodes (N index) was evaluated in both groups, and we observed 33.8% of patients in D2 group with N index category <20%, compared with 16.5% in D1 ($P = .041$).

The overall 5-year survival rate was 50.4% (95% confidence interval [CI], 37.95%–62.84%) in D1 and 64.9% (95% CI, 53.52%–76.28%) in D2 when any cause of death was considered ($P = .0309$; Fig. 1). When mortality related only to gastric carcinoma for advanced pathologic tumor stages (II to IV) was considered, the 5-year survival rate in D2 was significantly higher (50.58%; 95% CI, 36.34%–64.82%) than in D1 (41.45%; 95% CI, 26.99%–55.91%; $P = .04$) (Fig. 2; Table 3).

The independent prognostic factors identified by multiple Cox regression analysis are listed in Table 4. Hazard ratios (HRs) are expressed taking as references those categories with best prognosis (stages 0 and I by the 1997 tumor-node-metastasis classification, a <20% lymph node ratio, absence of distant metastases, intestinal histological Laurén type of tumor, and patients with extended [D2] lymphadenectomy).

When we adjusted the Cox model for age, ASA index, tumor stage, presence of distant metastases, lymph node ratio (N index), extent of lymphadenectomy (D1 or D2), and associated radiotherapy, the HR for D1 versus D2 was 2.32 (95% CI, 1.25–4.30). When we stratified the multivariate model for the tumor stage variable (by using five categories instead of introducing tumor stage as an independent variable), the HR for D1 versus D2 was 2.42 (95% CI, 1.25–4.68).

DISCUSSION

The usefulness of EL for increasing survival in patients with resectable gastric cancer is probably the most controversial topic in the surgical management of this disease. The EL technique, which involves the dissection of more nodes than those invaded by the tumor, was first described and used by Japanese surgeons[4] as a radical surgical treatment for resectable gastric cancer and resulted in increased survival rates.

Gastric cancer recurrence patterns (50% of recurrences take place in regional lymph nodes[16]) and the good Japanese clinical results seemed to confirm the benefits of this technique. Several nonrandomized Japanese studies[2,3,17–19] showed a 5-year survival rate as high as 50% or 75% (depending on whether there was tumoral invasion of the regional lymph nodes) when an EL was performed.

Because these data were significantly better than any Western series published,[6,20] the EL technique began to be applied by Western surgeons, who, however, observed an increased postoperative morbidity without improved survival rates. Given these conflicting results, two large multicenter randomized studies[7,8] were performed and demonstrated no survival benefit with EL. At the same time, several Western authors published nonrandomized studies[21–25] performed in specialized gastric cancer surgery centers, and these showed a higher survival rate.

In our study, we retrospectively analyzed 156 patients with resected gastric cancer operated on in a single institution by the same group of 3 surgeons. Eighty-one underwent a D1 lymphadenectomy, and 71 underwent an extended (D2) lymphadenectomy consisting of excision of the N1 and N2 Japanese classification lymph node levels[4] and those located along the hepatoduodenal ligament, as well as a sampling of para-aortic, retropancreatic, and mesenteric nodes.

We studied two well-balanced groups that differed only in age, ASA index, type of gastrectomy, and associated radiotherapy. No systematic criteria were used to assign patients to a group. We have ample reason to think that no bias existed in the assignment of patients to each group. In addition, we applied a multivariate Cox model to control for confounding, adjusting for all the potential prognostic variables and stratifying for tumor stage.[15]

In relation to postoperative morbidity, we did not find any significant difference between the D1 and D2 groups. Operative differences observed (duration of surgery and production and maintenance of drains) did not imply a longer hospital stay in D2 (13.1 days) than in D1 (12.1 days), unlike data published by other authors.7,8,26

Overall morbidity was similar in D1 (48%) and D2 (53%); although these figures were apparently higher than those reported, this is because lesser complications are included (such as abdominal collections that did not need to be drained, urine infections, phlebitis, and so on). Despite this, the hospital stay (13 days) remains as short and the mortality rate (2%) in our series remains as low as data published by other gastric surgery specialty groups.5,22,23,25

The association of gastrectomy with other organ resection (such as splenectomy or pancreatectomy) has been related to an increased number of complications.[20] In our study, we extended the resection to other organs (colon, liver, or pancreas) when the surgeon observed macroscopic infiltration during the operation in the context of a theoretically R0 resection, because this is generally accepted. Nevertheless, we systematically performed splenectomy on all patients submitted to total gastrectomy without observing a higher morbidity, unlike other authors.[27]

The overall mortality rate (2%, corresponding to two patients in the D1 group who died) was lower than that published by the large multicenter prospective trials.[7,8] It seems that the greater specialization of the surgical team plays an important role in considering EL a safe procedure.

In our study, we observed that with the D2 operation, the 5-year survival in patients with tumor stages >I was higher (50.6%) than in the D1 group (41.4%). Multivariate analysis identified D2 lymphadenectomy as one of the five independent prognostic factors. Patients submitted to EL (D2) had a 2.32 times lower risk of tumoral death than those receiving D1, independent of tumor stage. The following variables were identified as other independent prognostic factors: pathologic tumor stage (patients with tumor-node-metastasis stages >I had a 11.66 times higher rate of mortality than those with stages 0 and I), Laurén histological classification (gastric-type tumors presented a worse prognosis than intestinal types), N index (patients with an N index category <20% showed a better prognosis), and the presence of distant metastases (referring to patients with positive peritoneal lavage cytology, invaded hepatoduodenal ligament lymph nodes, or macroscopic localized carcinomatosis at the bursa omentalis).

The median survival follow-up was 37 months; although it is necessary to observe longer-term results, data obtained in our study have relevance if we consider that most tumor recurrences occur within the first 2 years of surgical treatment. These encouraging results are consistent with those observed by Siewert et al.[23] and with most Japanese series,[2,3,17–19] but they differ from the recently published results of randomized multicenter trials.6,20

Recently the Dutch[7] and the British (Medical Research Council)[8] multicenter randomized studies concluded firmly that D2 is not a safe procedure and does not bring any advantage in the surgical treatment of gastric cancer. The Dutch study[7] randomized 711 patients with resectable gastric cancer operated on in 80 different hospitals over 4 years, and it reported similar 5-year survival rates in the D1 and D2 groups (45% and 43%, respectively). Despite being a theoretically well-designed study (supervised by experienced Japanese surgeons), they found 51% of protocol violations (defined as the absence of lymph nodes from more than two lymph node stations that were supposed to be harvested). The Medical Research Council[8] studied 400 patients treated with D1 and D2 and obtained no difference in 5-year survival (35% and 33%, respectively); nevertheless, their low median number of dissected lymph nodes (17 in D2 and 13 in D1) is the weak point of that study, because it is generally accepted nowadays that a correct lymphadenectomy must harvest at least a median of 25 lymph nodes.23,28

In our study, the median number of dissected lymph nodes in D2 was 31 and 14 in D1. These data are similar to some recently published series and are of great importance because the number of excised lymph nodes is considered as the quality control for a correct lymphad-enectomy[29] (the last 1997 tumor-node-metastasis classification[13] established a total number of 15 dissected nodes as necessary to properly stage gastric adenocarcinoma). Indeed, some authors[9] assert that EL should be used in any patient with resectable gastric cancer simply because it permits a better staging of this disease, be-cause the stage migration phenomenon cannot be demonstrated.

Both of these prospective multicenter studies[6,20] are good examples of how difficult randomizing a complex technique can be. They collected a large number of short experiences by many different surgeons and hospitals (80 hospitals in the Dutch study and 35 in the British study), and the likely bias of pooling in these studies might be larger than that of nonrandomized ones.

Although we used a nonrandomized design, our study has the strength of being conducted in a single institution (avoiding the problem of protocol violations) and comparing two well-balanced groups. In addition, we used a multivariate analysis to determine independent prognostic variables. The fact that the type of lymph node dissection performed has been identified as one of the main determinants of survival could add evidence to solve the dilemma about the benefits of lymphadenectomy, be-cause nowadays it is not always possible or ethically correct to randomize patients to a treatment when the application of a different oncologic therapeutic procedure offers unequal results. Our results suggest that EL should be the procedure of choice in the management of resectable gastric cancer at any location, provided that adequate morbidity and mortality figures are maintained.

REFERENCES

1. Heberer G, Teichmann RK, Kramling HJ, Gunther B. Results of gastric resection for carcinoma of the stomach: the European experience. *World J Surg* 1988;12:374–81.
2. Maruyama K, Gunven P, Okabayashi K, Sasako M, Kinoshita T. Lymph node metastases of gastric cancer. General pattern in 1931 patients. *Ann Surg* 1989;210:596–602.
3. Nishi M, Ichikawa H, Nakajima T, Maruyama K, Tahara E, eds. *Gastric Cancer.* Berlin: Springer-Verlag, 1994.
4. Kajitani T. The general rules for the gastric cancer study in surgery and pathology. Part I. Clinical classification. *Jpn J Surg* 1981;11: 127–39.
5. Smith JW, Shiu MH, Kelsey L, Brennan MF. Morbidity of radical lymphadenectomy in the curative resection of gastric carcinoma. *Arch Surg* 1991;126:1469–73.
6. Bonenkamp JJ, Songun I, Hermans J, et al. Randomised comparison of morbidity after D1 and D2 dissection for gastric cancer in 996 Dutch patients. *Lancet* 1995;345:745–8.
7. Bonenkamp JJ, Hermans J, Sasako M, Van de Velde C. Extended lymph-node dissection for gastric cancer. *N Engl JMed* 1999;340: 908–14.
8. Cuschieri A, Weeden S, Fielding J, et al. Patient survival after D1 and D2 resections for gastric cancer: long-term results of the MRC randomized surgical trial. Surgical Co-operative Group. *Br J Cancer* 1999;79:1522–30.
9. Brennan MF. Lymph-node dissection for gastric cancer. *N Engl JMed* 1999;340:956–8.
10. Roukos DH, Hottenrott C, Lorenz M, Koutsogiorgas-Couchell S. A critical evaluation of effectivity of extended lymphadenectomy in patients with carcinoma of the stomach. An analysis of early results and long-term survival. *JCancer Res Clin Oncol* 1990;116: 307–13.
11. Bonenkamp JJ, van de Velde CJ, Sasako M, Hermans J. R2 compared with R1 resection for gastric cancer: morbidity and mortality in a prospective, randomised trial. *EurJSurg* 1992;158: 413–8.
12. Roder JD, Bottcher K, Siewert JR, Busch R, Hermanek P, Meyer HJ. Prognostic factors in gastric carcinoma. Results of the German Gastric Carcinoma Study 1992. *Cancer* 1993;72:2089–97.
13. Fleming ID, Cooper JS, Henson DE, et al., eds. *AJCC Cancer Staging Manual.* 5th ed. Philadelphia: Lippincott-Raven, 1997.
14. Rutter TW, Tremper KK. Physical status classification of the American Society of Anesthesiologists (ASA). In: Greenfield LJ, Mulholland MW, Oldham KT, Zelenock GB, Lillemoe KD, eds. *Surgery: Scientific Principles and Practice.* 2nd ed. Philadelphia: Lippincott-Raven, 1997:446.
15. Lang TA, Secic M. *How to Report Statistics in Medicine.* Philadelphia: American College of Physicians, 1997.
16. Gunderson LL, Sosin H. Adenocarcinoma of the stomach: areas of failure in a re-operation series (second or symptomatic look) clinicopathologic correlation and implications for adjuvant therapy. *Int JRadiat Oncol Biol Phys* 1982;8:1–11.
17. Lee WJ, Lee WC, Houng SJ, et al. Survival after resection of gastric cancer and prognostic relevance of systematic lymph node dissection: twenty years experience in Taiwan. *World J Surg* 1995;19:707–13.
18. Shiu MH, Moore E, Sanders M, et al. Influence of the extent of resection on survival after curative treatment of gastric carcinoma. A retrospective multivariate analysis. *Arch Surg* 1987;122:1347– 51.
19. Yonemura YMD, ed. *Contemporary Approaches Toward Cure of Gastric Cancer.* Kanazawa, Japan: Maeda Shoten Co Ltd, 1996.
20. Cuschieri A, Fayers P, Fielding J, et al. Postoperative morbidity and mortality after D1 and D2 resections for gastric cancer: preliminary results of the MRC randomised controlled surgical trial. The Surgical Cooperative Group. *Lancet* 1996;347:995–9.
21. Pacelli F, Doglietto GB, Bellantone R, Alfieri S, Sgadari A, Crucitti F. Extensive versus limited lymph node dissection for gastric cancer: a comparative study of 320 patients. *Br J Surg* 1993;80:1153–6.
22. Bozzetti F, Marubini E, Bonfanti G, et al. Total versus subtotal gastrectomy: surgical morbidity and mortality rates in a multicenter Italian randomized trial. The Italian Gastrointestinal Tumor Study Group. *Ann Surg* 1997;226:613–20.
23. Siewert JR, Bottcher K, Stein HJ, Roder JD. Relevant prognostic factors in gastric cancer: ten-year results of the German Gastric Cancer Study. *Ann Surg* 1998;228:449–61.
24. Volpe CM, Koo J, Miloro SM, Driscoll DL, Nava HR, Douglass HO Jr. The effect of extended lymphadenectomy on survival in patients with gastric adenocarcinoma. *JAm Coll Surg* 1995;181: 56–64.
25. Roukos DH, Lorenz M, Encke A. Evidence of survival benefit of extended (D2) lymphadenectomy in western patients with gastric cancer based on a new concept: a prospective long-term follow-up study. *Surgery* 1998;123:573–8.
26. Dent DM, Madden MV, Price SK. Randomized comparison of R1 and R2 gastrectomy for gastric carcinoma. *Br J Surg* 1988;75: 110–2.
27. Wanebo HJ, Kennedy BJ, Winchester DP, Stewart AK, Fremgen AM. Role of splenectomy in gastric cancer surgery: adverse effect of elective splenectomy on longterm survival. *J Am Coll Surg* 1997;185:177–84.
28. Wagner PK, Ramaswamy A, Ruschoff J, Schmitz-Moormann P, Rothmund M. Lymph node counts in the upper abdomen: anatomical basis for lymphadenectomy in gastric cancer. *Br J Surg* 1991; 78:825–7.
29. Kodera Y, Yamamura Y, Shimizu Y, et al. The number of metastatic lymph nodes: a promising prognostic determinant for gastric carcinoma in the latest edition of the TNM classification. *J Am Coll Surg* 1998;187:597–603.

TABLE 1. *Characteristics of 156 patients with resected gastric cancer according to the extent of lymphadenectomy*

Variable	D1 (n = 85) (%)	D2 (n = 71) (%)	*P* value[a]
Age, y, mean (SD)	63.7 (11.3)	55.6 (11.4)	<.001
Male (%)	68 (80.0)	51 (71.8)	.232
ASA index			<.001
I	44 (51.8)	58 (81.7)	
II	34 (40.0)	13 (18.3)	
III	7 (8.2)	–	
Laure~n histological type[b]			.492
Gastric	45 (49.4)	44 (58.0)	
Intestinal	38 (45.8)	25 (36.2)	
Location of tumor			.318
Proximal	16 (18.8)	12 (16.9)	
Middle	20 (23.5)	21 (29.6)	
Distal	42 (49.5)	27 (38.0)	
More than two thirds of stomach	7 (8.2)	11 (15.5)	
Tumor size (cm)			.744
<5	25 (29.4)	21 (29.6)	
>5	53 (70.6)	50 (70.4)	
Depth of tumor invasion (T)			.902
Tis	4 (4.7)	2 (2.9)	
T1	21 (24.8)	17 (23.9)	
T2	8 (9.4)	5 (7.0)	
T3	41 (48.2)	35 (49.3)	
T4	11 (12.9)	12 (16.9)	
Regional node invasion (N)			.445
N0	38 (44.7)	26 (36.6)	
N1	29 (34.1)	22 (31.0)	
N2	11 (13.0)	13 (18.3)	
N3	7 (8.2)	10 (14.1)	
Distant metastases (M)			.251
M0	74 (87.1)	57 (80.3)	
M1	11 (12.9)	14 (19.7)	
Pathologic tumor staging (TNM 1997)			.871
0	4 (4.7)	2 (2.8)	
I			
IA	19 (22.4)	10 (14.1)	
IB	7 (8.2)	8 (11.3)	
II	10 (11.8)	9 (12.7)	
III			
IIIA	19 (22.4)	17 (23.9)	
IIIB	6 (7.0)	6 (8.5)	
IV	20 (23.5)	19 (26.7)	
Gastrectomy (type of resection)			
Total	37 (43.5)	71 (100)	<.001
Subtotal	48 (56.5)	–	
Extended surgery	8 (9.4)	9 (12.6)	.514
Pancreas	3 (3.5)	6 (8.4)	
Colon	2 (2.4)	3 (4.2)	
Liver	3 (3.5)	–	
Radiotherapy	23 (27.1)	33 (46.5)	.012
Chemotherapy	28 (32.9)	20 (28.2)	.520

TNM, tumor-node-metastasis; ASA, American Society of Anesthesiologists.
[a] Student's *t*-test or Pearson X^2 test.
[b] Information not available in two patients in D1 and two in D2.

TABLE 2. *Operative morbidity and mortality depending on the extent of lymphadenectomy*

Days of hospital stay[b]	12.1	(10.0–19.2)	13.1	(11.0–17.0)	.306
Operative morbidity (%)[c]		48.2		53.5	.511
General		14.1		8.4	.269
Pleuropulmonary					
Pneumonia		9.4		9.8	
Pleural effusion		9.4		15.5	
Atelectasis		9.4		12.6	
Acute edema		2.3		1.4	
Pneumothorax		1.1		–	
Cardiac		2.3		1.4	
Sepsis					
Catheter		8.2		12.6	
Blood culture		5.9		4.2	
Both		5.9		9.8	
Phlebitis		5.9		5.6	
Urine infection		3.5		5.6	
Other[d]		5.9		5.6	
Specific complications		34.1		45.0	.162
Hemorrhage		11.8		2.8	.037
Abscess		12.9		18.3	.355
Subphrenic		8.2		8.4	
Subhepatic		4.7		7.1	
Other		–		2.8	
Pancreatic fistula		2.4		8.5	.143
Dehiscence		5.9		5.6	1.000
Esophageal		–		2.8	
Duodenal		3.5		2.8	
Gastric		1.2		–	
Colonic		1.2		–	
Esophageal stenosis		3.5		–	
Evisceration		3.5		2.8	
Wound infection		5.9		1.4	
Operative mortality[e]		2.3		0	.295

[a] *P* calculated by Pearson X2 test, Fisher's exact test, or MannWhitney *U*-test.
[b] Median (25th–75th percentile).
[c] Morbidity includes the general and specific complications described previously.
[d] Includes alithiasic cholecystitis and metacarpophalangeal arthritis.
[e] Operative mortality includes the number of patients who died during the 30 postoperative days.

TABLE 3. *Five-year survival (%) depending on the eztent of lymphadenectomy (D1 or D2) for stages I through IV and T2/3*
N0/1 M0 according to the American Joint Committee on Cancer classification

Stage 0	4	100	2	100
Stage IA	19	75	10	100
Stage IB	7	100	8	100
Stage II	10	100	9	100
Stage IIIA	19	50.0	17	76.0
Stage IIIB	6	–[a]	6	–[a]
Stage IV	20	17.3	19	21.9
T2N0M0	5	100	3	100
T2N1M0	3	100	1	100
T3N0M0	7	71.4	8	875
T3N1M0	17	50.9	15	72.7

[a] There are no available data for 5-year survival. The longest follow-up period was 15 months for D1 and 44 months for D2.

TABLE 4. *Prognostic factors in patients with resected gastric cancer on the Cox regression model*

Prognostic factor	Hazard ratio	95% CI	*P* value[a]
Pathologic tumor stage (TNM)[b]			
0–1	1 (Ref)		
>1	11.66	1.43–94.94	.0025
Lymph node ratio (N index)[c]			
N <20%	1 (Ref)		
N ?20%	4.58	1.77–11.79	.002
Distant metastases (M)[d]			
M0	1 (Ref)		
M1	3.37	1.72–6.63	.0005
Laure~n classification			
Intestinal	1 (Ref)		
Gastric	2.78	1.47–5.25	.0009
Extent of lymphadenectomy (D)			
Extended (D2)	1 (Ref)		
Limited (D1)	2.32	1.25–4.30	.007

CI, confidence interval; TNM, tumor-node-metastasis; Ref, reference value.
[a] Likelihood ratio test for the multivariate comparison of hazard ratios (Cox model); the model was adjusted for all the variables shown in the table and for age (years), ASA index (three categories), and associated radiotherapy (yes/no).
[b] We have collapsed 0 and 1 TNM stages on a single category and merged together all other stages (II, III, and IV).
[c] N index = number positive divided by total number of lymph nodes, <20% and ?20%.
[d] M1 includes positive peritoneal lavage, invaded hepatoduodenal lymph nodes, or localized carcinomatosis in the bursa omentalis.

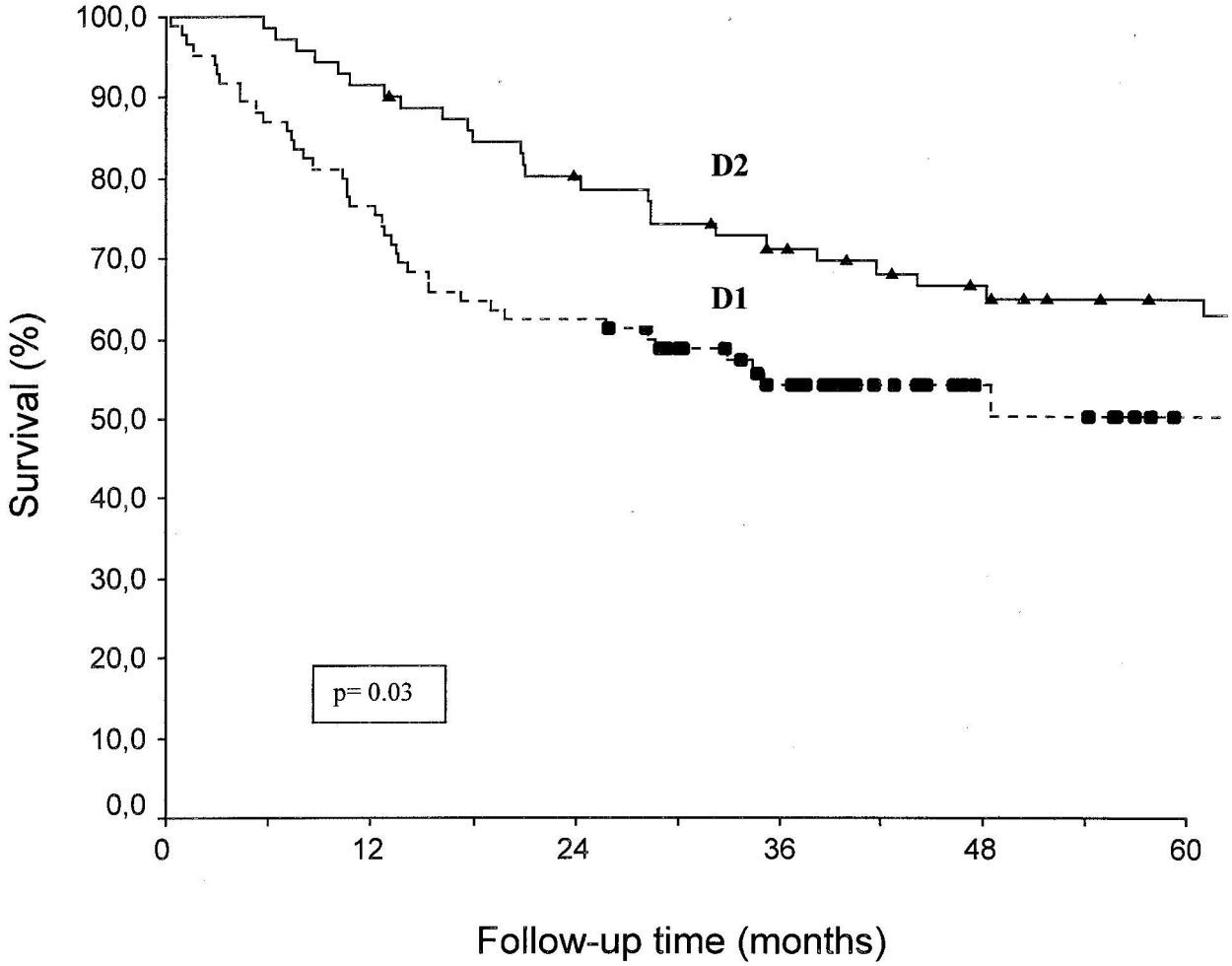

FIG. 1. Five-year survival considering overall mortality.

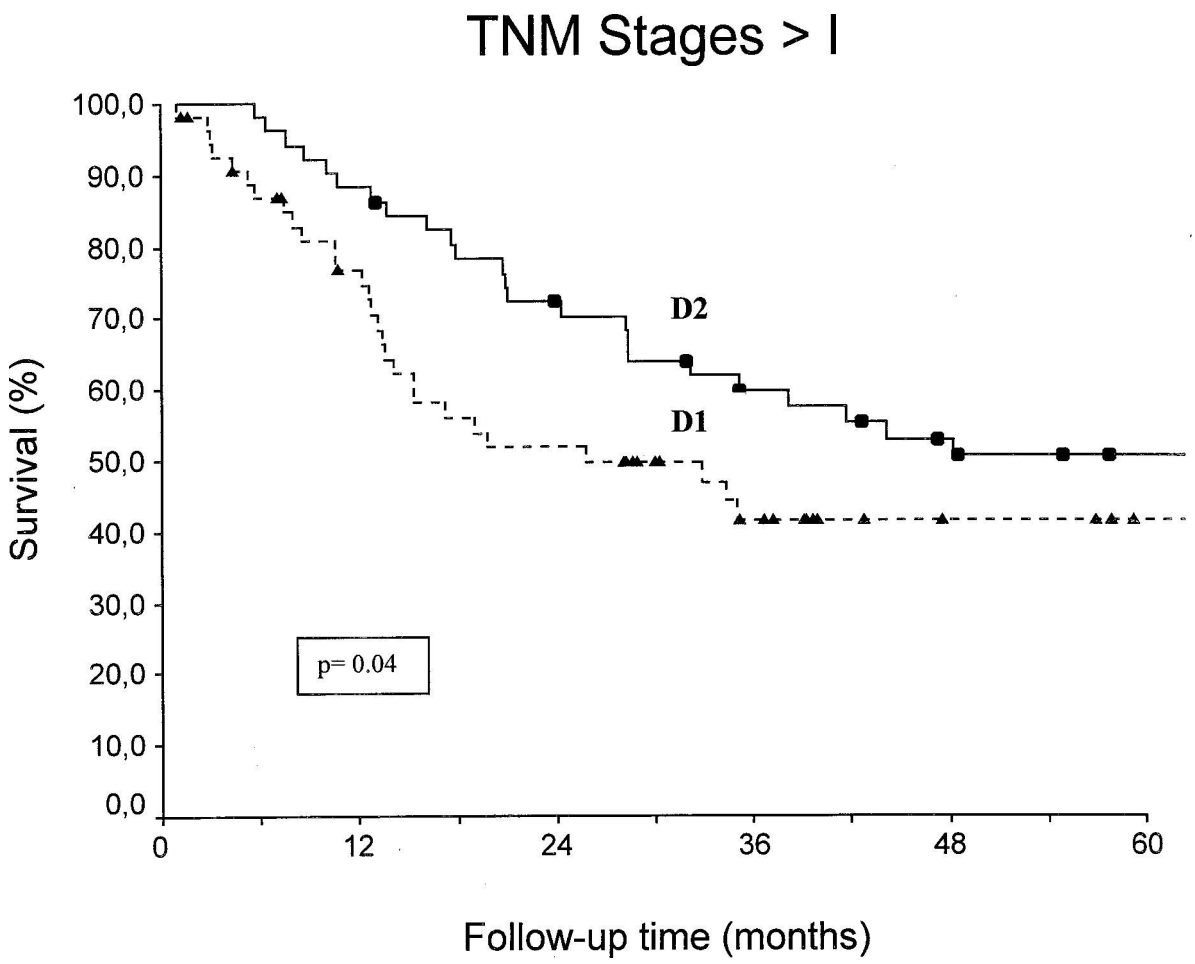

FIG. 2. Five-year survival considering mortality due to gastric carcinoma (tumor-node-metastasis [TNM] stages >I).