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The efficiency of D1(+) lymphadenectomy in signet ring cell carcinoma: comparison of postoperative early and late outcomes between standard lymphadenectomy and D1(+) lymphadenectomy

Şevket Barış Morkavuk [a], Serdar Çulcu[b], Mesut Tez[c] and Ali Ekrem Ünal[d]

[a]Department of Surgical Oncology, Ankara City Hospital, Ankara, Turkey; [b]Department of General Surgery, Dr.Abdurrahman Yurtaslan Research and Training Hospital, Ankara, Turkey; [c]Department of General Surgery, Ankara Research and Training Hospital, Ankara, Turkey; [d]Department of Surgical Oncology, Ankara University Faculty of Medicine, Ankara, Turkey

ABSTRACT

Signet ring cell carcinoma (SRCC) is a poorly cohesive subtype of gastric cancer. It is more aggressive than other types of gastric cancer. There is no special method for its treatment, but gastrectomy and lymphadenectomy is the standard approach. The aim of this study is to investigate postoperative outcomes of D1 lymphadenectomy and D1(+)lymphadenectomy in gastric SRCC.

A total of 358 cases whohad a gastrectomy performed forthe diagnosis of gastric cancer between 2013 and 2019 in Ankara University Medical Faculty, Surgical Oncology Department were retrospectively investigated. In all, 128 of the cases had SRCC in the final pathology. We separated the cases into two types,D1 lymphadenectomy and D1(+) lymphadenectomy. The 5-year survival, early mortality, hospital mortality and postoperative complication rates were evaluated.

There were 59 patients in the D1 group and 64 patients in the D1(+) group.Metastatic lymph node amount and therefore N stage was found to be significantly higher in the D1(+) group (p=0.00 and p=0.03, respectively). Postoperative chyle fistula was found to be significantly higher in the D1(+) group (p=0.003). There was no statistically significant difference between the groups with regard tomean survival (p=0.065);the 5-year mean survival was 21% in the D1 group and 7% in the D1(+) group.Present findings suggest that extended lymphadenectomy does not provide a benefit in cases of SRCC.

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KEYWORDS
Signet ring cell; peritoneal seeding; D1(+) lymphadenectomy; hospital mortality; long-term survival

1. Introduction

Gastric cancer is the fifth (5.7%) most common type of cancer amongst newly diagnosed cancer cases, and it is rated third (8.2%) in cancer mortality [1]. In spite of the increase in cancer incidence, cancer mortality is decreasing. This condition may be due to recent advancements in methods of early diagnosis and treatment. Especially in Japan, the 5-year survival rate reached up to 90%, while other countries showed rates of 10–30% [2,3]. Considering the data in our country, it is the fourth most common cancer in males and seventh most common cancer in females. The evaluation of the stages of cancer at the time of diagnosis showed distant metastasis in 27% of the cases [4].

There are various classification methods for gastric cancer (Who, Lauren, Goseki, Ming, Nakamura, Grundmann and Caneiro). Signet ring cell carcinoma (SRCC) is a poorly cohesive subtype of gastric cancer [5]. It is characteristically made of cells with mucin-rich cytoplasm and crescent-shaped nuclear structure [6]. Because of its characteristics, such as occurrence in younger ages, affinity to lymphatic metastases and peritoneal seeding, it is more aggressive than other types of gastric cancer. The incidence of this subtype is 3.4–39% amongst gastric cancers and is on the rise [7]. It is referred to as diffuse type in the Lauren classification, infiltrative type in the Ming classification and undifferentiated type in the Nakamura classification. There is no special method for its treatment, but gastrectomy and lymphadenectomy are the standard approaches.

Japanese Gastric Cancer Association (JGCA) defined lymphadenectomy types depending on the extent of gastrectomy. D1 lymphadenectomy includes nodes in stations 1 to 7, D2 lymphadenectomy includes D1 and nodes in stations 8,9,11p,11d and 12a [8]. In Western study groups, there are several studies showing that D2 lymphadenectomy does not increase mean survival but, on the contrary, increases mortality and morbidity rates [9]. Eastern group (especially Japanese study groups) studies showed that D2 lymphadenectomy increases mean survival in the long term. A Dutch group also published that D2 lymphadenectomy has higher mortality and morbidity rates, but they also showed lower locoregional recurrence and

CONTACT Şevket Barış Morkavuk drsbmor@yahoo.com Department of Surgical Oncology, Ankara City Hospital, Üniversiteler Mahallesi, Bilkent Caddesi N0=1, Onkoloji Binası, 6, Kat Ankara

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cancer-related mortality [10]. Western society, who could not quit on D2 lymphadenectomy due to lower locoregional recurrence rates, identified a new lymphadenectomy type named D1(+), also known as modified D2. In this method, which is used specifically by European surgeons, splenectomy and distal pancreatectomy are not the routine procedures. The lymph nodes of 10 and 11 distal and 12 anterior are not included in the dissection. Therefore, extended lymphadenectomy is achieved when compared to D1, and both the duration of surgery and postoperative morbidity are reduced in comparison to D2 lymphadenectomy. D1(+) lymphadenectomy is increasing in popularity due to the new studies, and it was included in the JGCA (5th edition) guide year 2018 [11].

In this study, the early- and late-term results of D1 and D1(+) lymphadenectomies were investigated in signet ring cell carcinoma (SRCC), which presents with a more aggressive character than other gastric cancer subgroups. The mortality, morbidity and mean survival rates of patients were evaluated. The aim was to have an idea of possible pros and cons of extended lymphadenectomy and standard lymphadenectomy for SRCC.

2. Materials and methods

A total of 358 cases who had gastrectomy performed to diagnose gastric cancer between 2013 and 2019 at Ankara University Medical Faculty, Surgical Oncology Department were retrospectively investigated. In all, 128 of the cases had SRCC in the final pathology. Four cases were excluded due to peritoneal metastasis and one case for neoadjuvant chemotherapy. The remaining 123 cases were included. Cases in which lymphatic station numbers 1 to 7 were defined in pathology reports were considered to be D1 lymphadenectomy, while cases involving D1 and lymphatic stations 8, 9 and 11p were named as D1(+) lymphadenectomy. We separated the cases into two types, D1 lymphadenectomy and D1(+) lymphadenectomy. The quantity of extracted lymph nodes was not taken into consideration when deciding on the type of lymphadenectomy. This condition was the main limitation of our study. Patients without station numbers in pathology results may as well have been performed D1(+) while being referred to as D1 lymphadenectomy in our study. However, we know that the width of a dissection is not defined with numbers but with dissection of a station. First, 5-year survival, early mortality, hospital mortality and postoperative complication rates were evaluated. Additionally, age, stage, lymphovascular invasion (LVI) and operation durations were compared between study groups.

3. Statistics

SPSS v22.0 was used in our study. Pearson's chi-square test and Fischer's exact test were performed in nominal crosstab. Student's T test was used for scale parametric data, and the Mann–Whitney U-test was used for non-parametric data. The cut-off value was calculated by using the ROC curve. The Kaplan–Meier method was performed for mean survival. $p < 0.05$ was considered statistically significant.

4. Results

In all, 123 patients were investigated retrospectively. Mean age was 61 (range 22–92) years; 78 patients were male and 45 patients were female. Mean age was 62 (range 22–92) years for male patients and 60 (range 31–88) years for female patients. A total of 66 patients had a total gastrectomy, of which 12 were laparoscopic. A total of 57 patients had a subtotal gastrectomy performed, of which 20 were laparoscopic. Ten patients had hospital mortality, and 47 patients developed early mortality in 1-year follow-up. Mean operational duration was 108 (range 62–170) minutes, mean follow-up duration was 26 (range 0–79) months (Table 1).

Patients were divided into two groups: D1 lymphadenectomy and D1(+) lymphadenectomy. There were 59 patients in the D1 group and 64 patients in the D1(+) group. There was no significant difference in terms of gender distribution between the two study groups. Mean age was 64.85 (range 31–92) years in the D1 group and 57.75 (range 22–87) years in the D1(+) group ($p = 0.008$). Thirty-three patients in each of the lymphadenectomy groups received a total gastrectomy. Mean lymph node dissection amount was 17 in the D1 group, while it was 30 in the D1(+) group ($p = 0.00$). Metastatic lymph node amount, and therefore N stage, was found to be significantly higher in the D1(+) group ($p = 0.00$ and $p = 0.03$, respectively). Mean operation duration was 90 minutes in the D1 group and 130 minutes in the D1(+) group. In all, 75% of the D1(+) group and 55.9% of the D1 group were found to be stage 3. Mean follow-up duration was found to be longer in the D1 group (28 ± 22.14 months vs. 22 ± 19.20 months) (Table 2).

Postoperative chyle fistula was found to be significantly higher in the D1(+) group ($p = 0.003$), and 86% of the 15 patients who developed chyle fistula were in the D1(+) group. None of them underwent reoperation, as the occurrence of a fistula was managed with a conservative approach. There was no statistically significant difference between the groups regarding overall patient mortality and first-year mortality. Seven out of 10 patients who had hospital mortality and 28 of 47 patients who had mortality in the first year were in the D1(+) group (Table 3).

Table 1. Demographic distribution of the patients.

Age, year, mean±SD	61,15 ± 15 (22–92)
Gender: n(%)	78 (63.41%)
Male	45 (36.59%)
Female	
Operation	**66 (53.65%)**
Total gastrectomy	54 (43.9%)
Open total gastrectomy	12 (9.8%)
Laparoscopic total gastrectomy	**57 (46.35%)**
Subtotal gastrectomy	37 (30.1%)
Open subtotal gastrectomy	20 (16.3%)
Laparoscopic subtotal gastrectomy	
T invasion degree	15 (12.2%)
T1	14 (11.4%)
T2	28 (22.8%)
T3	66 (53.7%)
T4	
N status	28 (22.8%)
N0	12 (9.8%)
N1	31 (25.2%)
N2	52 (42.3%)
N3	
Stage	17 (13.8%)
Stage 1	25 (20.3%)
Stage 2	81 (65.9%)
Stage 3	
Lvi status	42 (34.1%)
Negative	81 (65.9%)
Positive	
Metastatic node	28 (22.8%)
Negative	95 (77.2%)
Positive	
Metastatic node, number, mean	8 (0–42)
Hospital Mortality	113 (91.9%)
Negative	10 (8.1%)
Positive	
First year mortality	76 (61.8%)
Negative	47 (38.2%)
Positive	
Chylous Fistula	108 (87.8%)
Negative	15 (12.2%)
Positive	
Operation Duration, minute, mean±SD	108.31± (65–170)
Follow-up time, month, mean±SD	26.33 ± 21 (0–79)
Survey	59 (48%)
Live	64 (52%)
Death	

SD, standard deviation; Min, minimum; Max, maximum; Lvi, lymphovascular invasion.

Table 2. Association between lymphadenectomy and other clinicopathological factors.

Clinicopathological factors	No. of patients (%) D1 lymphadenectomy (59 patients 48%)	D1 + lymphadenectomy (64 patients 52%)	*P* value
Age, year, mean±SD	64.85 ± 13.75(31–92)	57.75 ± 15.13 (22–87)	***p*** = 0.008
Gender	41 (69.5%)	37 (57.8%)	*P* = 0.179
Male	18 (30.5%)	27 (42.2%)	
Female			
Operation	29 (49.2%)	25 (35.1%)	*p* = 0.353
Open total gastrectomy	4 (6.8%)	8 (12.5%)	
Laparoscopic total	19 (32.2%)	18 (28.1%)	
gastrectomy	7 (11.8%)	13 (20.3%)	
Open subtotal gastrectomy			
Laparoscopic subtotal gastrectomy			
T invasion degree	11 (18.6%)	4 (6.3%)	*p* = 0.170
T1	5 (8.5%)	9(14.1%)	
T2	12 (20.3%)	16 (25%)	
T3	31 (52.5%)	35 (54.7%)	
T4			
N status N0	18 (30.5%)	10 (15.6%)	***p*** = 0.030
N1	7 (11.9%)	5 (7.8%)	
N2	17 (28.8%) 17	14(21.9%)	
N3	(28.8%)	35 (54.7%)	
Stage	11 (18.6%)	6 (9.4%)	*p* = 0.080
Stage 1	15 (25.4%)	10 (15.6%)	
Stage 2	33 (55.9%)	48 (75.0)	
Stage 3			
Metastatic node	18 (30.5%)	10 (15.6)	***p*** = 0.049
Negative	41 (69.5%)	54 (84.4)	
Positive			
Metastatic node, number, median±SD	3 ± 5,49 (0–20)	9 ± 11.09 (0–42)	***P*** = 0.00
Lymph node dissection number, median±SD	17 ± 4.74 (7–27)	30 ± 10.46 (17–70)	***p*** = 0.00
Tumor Location	27 (45.8%)	33 (51.6%)	*p* = 0.668
Distal	17 (28.8%)	15 (23.4%)	
Middle	14 (23.7%)	13 (20.3%)	
Upper	1 (1.7%)	3 (4.7%)	
Entive			
Operation Duration, minutes, median±SD	90 ± 12.08 (65–120)	130 ± 15.48 (90–170)	***p*** = 0.00
Follow-up time, month, median±SD	28 ± 22.14 (0–79)	22 ± 19.20 (0–75)	*p* = 0.106

In the multiple variant analysis, the number of extracted lymph nodes, metastatic lymph nodes, chyle fistula development and duration of operation were evaluated between the two groups. There were significant differences between the groups regarding dissected lymph node amount (OR = 0.520, 95% CI:0.322–0.842, p = 0.08) and operation duration (OR = 0.771,95% CI: 0.654–0.909, p = 0.02). The accuracy rate was 98.4% (Table 4).

We calculated the cut-off value for operation duration, number of dissected lymph nodes and metastatic lymph nodes by using the ROC curves of the lymphadenectomy groups. We found that both the operation duration and lymph node dissection number were highly and statistically significant (Figure 1). According to our results, the D1(+) group had more cases with operation duration >105 minutes, extracted lymph node amount >22.5 and metastatic lymph node amount >4.5.

There was no statistically significant difference between the lymphadenectomy groups with regard to patient mortality. However, there was a significant positive correlation between operation duration and patient mortality. The cut-off value of cases with hospital mortality for operation duration was 115 minutes (Figure 2). Patients with an operation duration over 115 minutes had higher hospital mortality. Hospital mortality was evaluated between the lymphadenectomy groups on the basis of the cut-off value for operation duration, and no statistically significant difference was found (Table 5). Around 30% of the patients who were exitus during the follow-up were the patients who had an operation duration <115 minutes and who underwent D1 lymphadenectomy. Seventy percent percent of them were D1(+) patients with over 115 minutes of operation.

Mean survival curves were calculated by Kaplan–Meier analysis. There was no statistically significant difference between the groups with regard to mean

Table 3. Postoperative outcomes of D1 and D1 + lymphadenectomy.

Clinical factors	No. of patients (%) D1 lymphadenectomy (59 patients 48%)	D1 + lymphadenectomy (64 patients 52%)	*P* value
Hospital Mortality	56(94.9%)	57 (89.1%)	*P* = 0.327
No	3 (5.1%)	7 (10.9%)	
Yes			
First year Mortality	40 (67.8%)	36 (56.3%)	*P* = 0.188
No	19 (32.2%)	28 (43.8%)	
Yes			
Chylous Fistula	57 (96.9%)	51 (79.7%)	***p*** = 0.004
No	2 (3.4%)	13 (20.3%)	
Yes			

Table 4. Multivariate logistic regression analysis of lymphatic dissection groups with clinicopathological variables.

Clinicopathological variables	Lymphatic dissection groups OR (% 95 CI)	*P*
Lymph node dissection	0.520 (0.322–0.842)	**0.08**
Operation duration	0.771 (0.654–0.909)	**0.02**

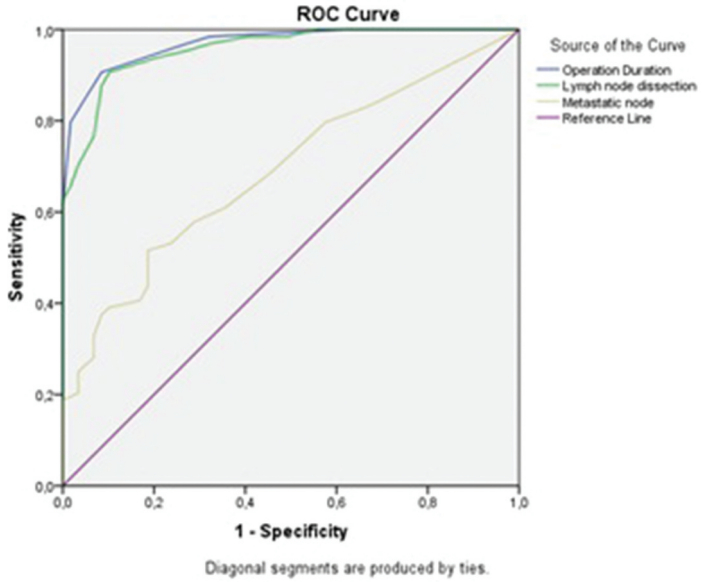
survival curves (log rank p = 0.065) (Figure 3). The 5-year mean survival was 21% in theD1 group and 7% in the D1(+) group (Table 6).

The overall 5-year survival of patients of the same gender was no difference between the lymphadenectomy groups (p = 0.052). However, when the gastrectomy technique and lymphadenectomy groups were evaluated together, we found a statistically significant difference (p = 0.048). The 5-year mean survival rate of patients who underwent a subtotal gastrectomy plus D1 lymphadenectomy was 33%, which is higher than other patient groups (Table 7).

5. Discussion

Gastric cancer is a heterogenous disease. Its behaviour differs according to histopathological diagnosis and anatomic location. There are several histopathological categorizations. SRCC is a type of cancer that involves clear mucin in its cytoplasm, which has a crescent-shaped nuclear structure [5]. SRCC is considered to have a worse prognosis in many studies. It has high lymphatic affection and peritoneal metastasis rates [7]. Despite its aggressive nature, there is no special surgical procedure, and lymphatic dissection is defined for SRCC. We have investigated the outcomes of standard D1 lymphadenectomy and D1(+) lymphadenectomy. At the same time, we had the opportunity to compare the data of patients with SRCC in our study with recent data in the literature.

Although there is a reduction in gastric cancer incidence, SRCC is predisposed to increase. Maehara et al. observed SRCC rates of 3.4% in the year 1992, while this rate was found to be 21.5% in the study of Chon et al. in 2017 [12,13]. Several studies have



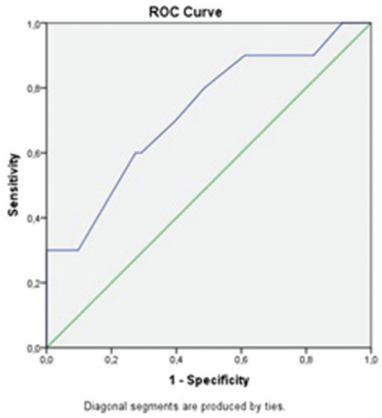
Operation Duration cut-off= 105 minutes ***P <0,05***

Lymph Node Dissection cut-off= 22,5 ***P <0,05***

Metastatic Node cut-off= 4,5 ***P< 0,05***

Figure 1. ROC Curve analysis for operation duration, lymph node dissection, metastatic node in lymphadenectomy groups.

Clinical Factors	Hospital Mortality (+) patients	(-) patients	P value
Operation Duration	10	113	P=0.018



Cut-off value of cases with hospital mortality for operation duration = 115 minutes ***P=0,019***

Figure 2. Correlation between hospital mortality and operation duration.

Table 5. Comparison of hospital mortality rates in D1 and D1(+) lymphadenectomy with operation duration cut-off value.

	No. of patients (%)					
	<115 min		>115 min			
Clinical factors	D1	D1(+)	D1	D1(+)	*P* value	
Hospital Mortality	55 (80.9%)	13 (19.1%)	1 (2.2%)	44 (97.8%)	$P = 0.40$	$P = 0.69$
No	3 (100%)	0 (0%)	0 (0%)	7 (100%)		
Yes						

shown wider ranges (8–30%). In the study of 1439 patients by Zhang et al., this rate was found to be 15.1%, and in another study by Bamboat et al., the SRCC rate was 36.9% [14,15]. In our study, we found SRCC in 35.7% of all the cases, which is consistent with the literature.

SRCC is more common in females. This condition may be related to sex hormones (i.e. oestrogen) [16]. However, there is no evidence or consensus to support this thesis. In the study by Matsuyama et al., which included 29 patients, the oestrogen receptor was investigated in gastric cancer. Lacking gender discrimination, gastric cancer cells were positive for oestrogen. In SRCC cells, the cytoplasm was also positive for oestrogen, in addition to the nucleus [17]. Of course, we cannot use a study with such few participants as a reference. Yet, in this study, SRCC cells had different oestrogen receptors than other types of cancer. In our study, 36.5% of patients were female, and there was a male predominance.

In recent studies, it was found out that the 5-year survival rates of patients with SRCC were lower than those of patients with non-SRCC. In a study conducted by Liu et al., the 5-year survival rates of patients with non-SRCC and patients with SRCC were 49.5% and 36.2%, respectively [18]. In another study by Zhang et al., it was 44.9% and 36%, respectively [14]. In our study, the 5-year survival rate of patients with SRCC was 14%, which is considerably lower than in the recent literature. We explain this condition to be due to the fact that most of the cases in our study were in T4, N3 and therefore stage 3. Besides, the rates of early diagnosis of gastric cancer are low in our country. Considering invasion depth, we accepted T1 and T2 as early-stage and T3 and T4 as late-stage wall invasion. Subsequently, we investigated their 5-year survival rates. We found that the 5-year survival rate was 35% for T1 and T2 SRCC patients, 23% for T3 patients and 6% for T4 patients. Zhang et al. reported a 77.8% 5-year survival rate for T1 patients and a 16% 5-year survival rate for T4 patients [14]. In conclusion, even without lymph node metastasis, T4 patients had considerably low mean survival rates in our study and in the literature.

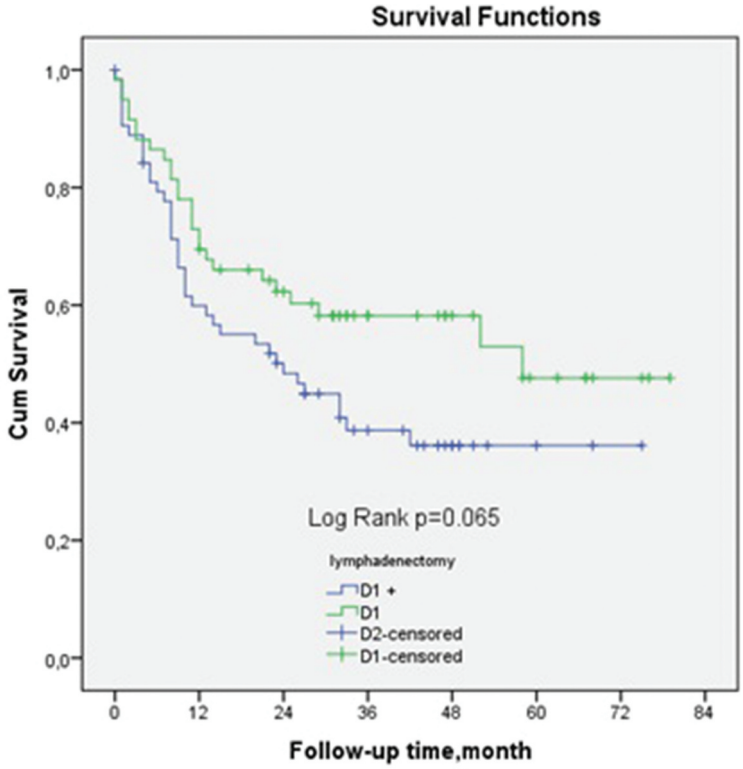


Figure 3. Univariate analysis of lymphadenectomy in signet ring cell gastric carcinoma by Kaplan–Meier method.

Table 6. Average survival rates by months.

Month	12	24	36	48	60
D1	72%	59%	44%	35%	21%
D1 (+)	59%	48%	31%	19%	7%

Lymphadenectomy and gastrectomy are the standard procedures for gastric cancers. The lymph node stations of the stomach are anatomically categorized and numbered according to the Japanese Gastric Cancer Association (JGCA) [19]. Accordingly, another lymphadenectomy was defined, in which D1, D2, D3 and lately 10, 11d and 12a are not extracted, which means splenectomy and distal pancreatectomy are not performed, which is named D1(+)(D1.5). In our study, the number of extracted lymph nodes was 17 ± 4.74 in the D1 group and 30 ± 10.46 in the extended lymphadenectomy group. This was statistically significant and similar to the literature. Ichikura et al. reported a study comparing D1, D1(+) and D2 lymphadenectomy, the rates were 32 ± 15, 37 ± 15 and 39 ± 16, respectively [20]. However, current studies are concentrated between the D1 and D2 lymphadenectomy groups, while studies on D1(+) lymphadenectomy are relatively low. The lymphadenectomy rates were 18.4 vs. 31.5 in the study of Bonenkamp et al. and 20 vs. 28 in the study of Wohnrath et al. [21,22]. On the other hand, there is no study of isolated SRCC that compares lymphadenectomies, and there is no additional suggestion for the extent of lymphadenectomy.

In the study by Wohnrath et al. that compared D1 and extended lymphadenectomy, 21 of 28 patients who developed hospital mortality were in the extended lymphadenectomy group. In another study by a Dutch group, 48 of 81 mortal patients were also in the extended lymphadenectomy group [21,22]. Postoperative complications were also found in 311 patients in the Dutch group study, of which 183 patients were in the extended lymphadenectomy group. Wohnrath et al. reported 60 postoperative

Table 7. Comparison by age, gender,operation of 5-year survival rates between D1 and D1+ lymphadenectomy of signet ring cell gastric carcinoma.

Patient characteristics	D1 lymphadenectomy	D1(+) lymphadenectomy	*P* value
Age	33%	10%	***P*** = 0.031
<60	25%	5%	*P* = 0.052
>60	15%	3%	***P* = 0.048**
Gender	18%	13%	
Male	33%	10%	
Female	15%	4%	
Operation			
Subtotal gastrectomy			
Total gastrectomy			

complications in 582 patients, and 46 patients were in the extended lymphadenectomy group and 14 were in the D1 lymphadenectomy group. However, all these studies lack consideration of pathological subgroups of gastric cancer, as we have explained before. In our study, the hospital mortality and first-year mortality of patients with SRCC were higher in the D1(+) group. Additionally, it was found that postoperative chyle fistula and operation duration were significantly higher in the D1(+) group. In the multivariate analysis, upon significant results in operation duration in the D1(+) group, we studied a cut-off value of 115 minutes. When operation duration and hospital mortality were evaluated, excluding the type of dissection, it was found that hospital mortality was higher in cases lasting >115 minutes. However, when it was evaluated together with the type of dissection, there was no significant difference, despite hospital mortality being higher in the D1(+) group. In other words, in our data, we could say that prolonged operation duration was an independent risk factor for hospital mortality in cases of SRCC.

In the studies conducted by Lam et al., Cuschieri et al. and the Dutch group, which compared D1 and extended lymphadenectomy, no significant difference was found regarding 5-year mean survival rates, regardless of histopathological subgroup [23–25]. Ichikura et al. reported a study comparing D1, D1(+) and D2 lymphadenectomy, the results showed no significant difference in the mean 5-year survival rates, accordingly [20]. In the study by the Dutch group in 2010, there was also no significant difference in 15-year mean survival rates (21% vs. 29%) and cancer-related mortality (48% vs. 37%, p = 0.01); locoregional recurrence rates were significantly lower in D2 cases. D1 and extended lymphadenectomy studies have shown us that the extent of dissection does not increase mean survival. On the contrary, it has high morbidity and mortality rates. The only significant result is that it provides lower locoregional recurrence rates in 15-year follow-up [10]. The question is, in patients with SRCC, which have high lymph node and peritoneal metastases and low mean 5-year survival rates, does extended lymphadenectomy provide any benefit for mean survival? In other words, should we perform extended lymphadenectomy for SRCC when we do not expect long-term survival? When we dug up the literature, we could not find an answer to this question. There was no statistically significant difference between the D1 and D1(+) lymphadenectomy groups regarding 5-year survival rates in our study. On the contrary, the D1 group had a higher mean survival rate. However, we can link this condition with high mortality in the D1(+) group of our study. Seven out of 10 patients who had hospital mortality and 28 out of 47 patients who had 1-year mortality were in the D1(+) group. By now, there are seven patients in the D1 group and three patients in the D1(+) group who have completed their 5-year follow-ups. The longest follow-up was 79 months in the D1 group and 75 months in the D1(+) group. We continue to do follow-ups and we will re-evaluate the mean survival rates at the end of 10 years.

6. Conclusion

In summary, we found that hospital mortality and postoperative chyle fistula rates were higher in the D1(+) lymphadenectomy group in patients with SRCC. Operation duration and hospital mortality due to prolonged operation duration were also higher in the D1 + lymphadenectomy group. We could not find a significant difference in the 5-year survival rates between D1 and D1(+) lymphadenectomy. In conclusion, the present findings suggest that extended lymphadenectomy does not provide a benefit in patients with SRCC, but more studies are needed that provide a wider series and more data parameters in order to acquire a definite result.

Abbreviations

SRCC: Signet ring cell carcinoma; SRCGC: Signet ring cell gastric cancer; AJCC: American joint committee on cancer; NCCN: national comprehensive cancer network; JGCA: Japanese gastric cancer association; 11p: 11 proximal; 11d: 11 distal; 12a: 12 anterior; OS: Overall survival

Disclosure statement

No potential conflict of interest was reported by the author(s).

Statements to comply with ethical requirements: Approval was received from the Ethics

Committee of Ankara City Hospital.

Institutional review board statement

This study was reviewed and approved by the Ethics Committee of the Ankara City Hospital. Confirmation number is E1/166/2019.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

Şevket Barış Morkavuk: Manuscript editing and preparation
Serdar Çulcu: Quality control of data and algorithms
Mesut Tez: Statistical Analysis
Ali Ekrem Ünal: Study concepts and design

ORCID

Şevket Barış Morkavuk http://orcid.org/0000-0003-0441-0333

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