

# Optimized Lymphadenectomy for Early Gastric Cancer Based on the Analysis of 1141 Cases from a Single Institution

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## Abstract

**Background:** According to the treatment guidelines for gastric cancer in Japan (3rd edition), D1 lymphadenectomy is recommended for T1a cancer (out of indication for endoscopic resection) and a group of T1b cancer (differentiated type, not larger than 1.5cm and clinically N0). D1+ lymphadenectomy is recommended for T1b cancer other than above group. D2 lymphadenectomy is for clinically N+ early gastric cancer (EGC). **Methods:** Consecutive 1141 resected EGC cases in our institution from January 1991 to December 2013 were analyzed. The size, depth of wall invasion, presence of ulcer, histological type and distribution of metastasis positive lymph node were evaluated. **Results:** There were 678 T1a and 463 T1b cancers. Lymph node metastasis positive T1a were 11 cases. All of them were undifferentiated type and the metastasis positive lymph nodes were all confined to the D1 area. Lymph node metastasis positive T1b cancer was 82 cases. Among them, 70 cases were within D1 area, 77 cases were within D1+ area and 79 cases were within D2 area. The other 3 cases had metastasis positive lymph node in beyond the D2 area. **Conclusion:** D1 lymphadenectomy is enough for T1a EGC that is out of indication of endoscopic resection and D1+ lymphadenectomy is reasonable for T1b EGC. These cases are good indication of laparoscopic surgery. D2 lymphadenectomy is required for T1b undifferentiated cancers which size is larger than 4 cm.

## Keywords

Early Gastric Cancer, Lymphadenectomy, Laparoscopic Surgery

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## 1. Introduction

D2 lymphadenectomy without routine splenectomy and pancreatic tail resection is now becoming the standard operation method for advanced resectable gastric cancer. The Dutch trial did not support the benefit of D2 lymphadenectomy as the complication rate and the postoperative death was significantly high in D2 lymphadenectomy group compared to D1 lymphadenectomy group [1]. However, as the long term survival analysis of this trial has proven that the locoregional recurrence and gastric cancer related death rate were lower in D2 lymphadenectomy group, the author recommended D2 lymphadenectomy as a standard procedure at a high volume center for advanced resectable gastric cancer [2]. The result of JCOG9501 has demonstrated that extended D3 lymphadenectomy did not improve survival compared to D2 lymphadenectomy [3]. Additionally, as the removal of No.10 and 11 lymph nodes by splenectomy showed no survival benefit, D2 lymphadenectomy without routine splenectomy and pancreatic tail resection in experienced hands is considered to be the standard for advanced resectable gastric cancer, both in Asian and in Western patients [4] [5].

On the other hand, limited surgery and less invasive surgery has become a standard procedure for early gastric cancer (EGC) recently. In the treatment guidelines for gastric cancer in Japan (3rd edition, 2010) [6], the indication of lymphadenectomy for EGC was defined as in **Table 1**. According to this guideline, D2 lymphadenectomy is required when lymph node metastasis was suspected by preoperative examination. However, Yoshikawa T *et al.* claims that D2 lymphadenectomy should be limited for EGC as there was little survival benefit [7]. The problems to solve are as follows. First, as the target is “early”, the curability should not be ruined. Second, which type of tumor can be the indication of limited surgery? Third, which type of tumor requires D2 lymphadenectomy? Forth, which type of tumor cannot be cured by surgery alone?

We, herein, report an analysis of 1141 EGC cases and reached to one direction that may help to solve these problems.

## 2. Patients and Methods

Surgically resected consecutive cases from January 1991 through December 2013 in our institution were analyzed. The size, macroscopic type, histological type, presence of ulcer, depth of wall invasion, lymphovascular invasion, operation method, metastasis of resected lymph node and their number are described according to the Japanese classification of gastric carcinoma. The lymph node number according to the Japanese classification of gastric carcinoma and the definition of lymphadenectomy according to the treatment guidelines for gastric cancer in Japan (3rd edition), namely D1, D1+ and D2 for each operative method are shown in **Figure 1**. Relation between the characteristics of the tumor and the cancer positive lymph node number was evaluated.

## 3. Results

### 3.1. Characteristic of 1141 EGC Cases

The characteristic of 1141 EGC cases is shown in **Table 2**. The T1a (mucosal) cancer was 678 cases (59.4%) and T1b (submucosal) cancer was 463 cases (40.6%). Lymph node negative cases were 1018 cases (89.2%) and

**Table 1.** Indication of lymphadenectomy for EGC by the guideline.

D1: T1a cancer that is no indication for EMR/ESD T1b, differentiated type, $\leq 1.5$ cm, cN0
D1+: T1b, other than the above, cN0
D2: T1b, cN+
EMR: endoscopic mucosal resection
ESD: endoscopic submucosal dissection
cN0: clinically lymph node metastasis negative
cN+: clinically lymph node metastasis positive



**Table 2.** Characteristic of resected cases (n = 1141).

Sex	Male	727
	Female	414
Age	Male	64.9
	Female	66.0
Lesion	U area	149
	M area	620
	L area	372
Operative method	total gastrectomy	128
	distal gastrectomy	930
	proximal gastrectomy	55
	partial resection	28
T-factor	T1a	678
	T1b	463
LN metastasis	N0	1018
	N1	61
	N2	26
	N3	6
	NX	30
Stage	IA	1018
	IB	61
	IIA	25
	IIB	6
	IV	1
	Unknown	30

LN: lymph node.

**Table 3.** LN metastasis positive T1a EGC (n = 11).

Histology	Differentiated	0
	Undifferentiated	11
size (mm)	20 - 80	mean 33.0
Ulcer	Presence	9
	Absence	1
	Unknown	1
Operation	Total	1
	Distal	10
	Proximal	0
	Partial	0
LN resection	D1	0
	D1+	0
	≥D2	11
N factor	N1	9
	N2	1
	N3	1
Stage	IB	9
	IIA	1
	IIB	1
range	≤D1	11
	D1 ≤ D1+	0
	D1+ ≤ D2	0

LN: lymph node.

### 3.3. Lymph Node Positive T1b Cancers

The detail of lymph node positive T1b cancers is shown in **Table 4**. There were 82 lymph node positive cases out of 463 T1b cancers (17.7%). The histology of these cases was 40 differentiated type and 42 undifferentiated type. There were 52 N1 cases, 25 N2 cases and 3 N3 cases. The cancer positive lymph nodes were confined to D1 region in 70 cases (85.4%), D1+ region in 7 cases (8.5%) and D2 region in 2 cases (2.4%). And, lymph node metastases were expanded to beyond the D2 region in the remaining 3 cases (3.7%). The cases which had cancer positive lymph node further than D1 are shown in **Table 5**. There was one case which does not meet the criteria

**Table 4.** LN metastasis positive T1b EGC (n = 82).

Histology	Differentiated	40
	Undifferentiated	42
Size (mm)	8 - 100	Mean 35.5
Operation	Total	11
	Distal	63
	Proximal	8
	Partial	0
LN resection	D1	11
	D1+	5
	≥D2	65
	Unknown	1
N factor	N1	52
	N2	25
	N3	5
Stage	IB	52
	IIA	24
	IIB	5
	IV	1
Range	≤D1	70
	D1 ≤ D1+	7
	D1+ ≤ D2	2
	>D2	3

LN: lymph node.

**Table 5.** Detail of LN metastasis positive T1b cases classification by range.

	Histology	Size (mm)	Operation	N factor	Stage	Positive LN number
D1 ≤ D1+	Differentiated	25	Distal	1	IB	No.3: 1/2, No.9: 1/3
	Differentiated	14	Distal	2	IIA	No.3: 1/14, No.5: 1/1, No.8a: 1/1
	Differentiated	20	Distal	2	IIA	No.1: 1/1, No.3: 1/4, No.4: 1/2, No.6: 1/3, No.8a: 1/2
	Undifferentiated	25	Total	2	IIA	No.3: 4/5, No.7: 1/3, No.8a: 1/4
	Differentiated	25	Distal	2	IIA	No.6: 2/2 No.8a: 1/1
	Undifferentiated	27	Distal	2	IIA	No.6: 3/6, No.8a: 1/5
	Undifferentiated	14	Distal	2	IIA	No.6: 2/6, No.8a: 1/2
D1+ ≤ D2	Undifferentiated	40	Distal	3	IIB	No.1: 2/4, No.3: 3/3, No.7: 1/1, No.8a: 1/1, No.12a: 1/4
	Undifferentiated	43	Distal	3	IIB	No.3: 6/15, No.6: 1/4, No.12a: 1/4
>D2	Undifferentiated	40	Total	2	IIA	No.3: 3/6, No.16: 1/1
	Differentiated	47	Distal	2	IIA	No.3: 1/12, No.6: 3/3, No.7: 1/3 No.14v: 1/3
	Undifferentiated	35	Total	2	IIA	No.3: 1/9, No.6: 4/5, No.14v: 1/1

LN: lymph node.

of Treatment guidelines for gastric cancer in Japan 3rd edition (**Table 1**). Though this case was differentiated type and the size was smaller than 1.5 cm, there was a cancer positive lymph node in No.8a which belongs to D1+ region. Two cases had cancer positive lymph nodes in No.12a area. These cases were both undifferentiated type, the tumor was at the lesser curvature of the L area (lower 1/3) and larger than 4 cm in size. Furthermore, these cases had multiple cancer positive lymph nodes at No.3. This suggests that this criterion requires D2 resection. There were three cases with cancer positive lymph nodes further than D2 region. One case had cancer positive lymph node at No.16 and the other cases had cancer positive lymph node at No.14v. The histology of No.16 positive case was undifferentiated type and the size was 4 cm which was similar to No.12a positive cases. For the No.14v positive cases, the tumor was at the L area and mainly at the greater curvature and also had multiple cancer positive lymph nodes at No.6.

#### 4. Discussion

The dilemma in treating EGC is how to take balance between curability and invasiveness of the treatment strategy. There is no question that endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) are less invasive therapy. However, the indication is basically limited to T1a cancers. The standard procedure for EGC that is out of indication of EMR/ESD will be surgical resection with lymphadenectomy as the possibility of lymph node metastasis rises. Nevertheless, as the frequency of lymph node metastasis of EGC is low, it has to say that unnecessary lymphadenectomy was performed in many cases. Sentinel node navigation surgery has been expected as an effective therapy to reduce such unnecessary lymphadenectomy. However, this method still requires further research and has difficulty in avoiding false negative judgement. It needs more time to become a standard procedure [8] [9]. Thus, at present, we have to determine the range of lymphadenectomy by the information obtained from the preoperative examination.

In this study, the cancer positive lymph nodes of T1a were all within D1 range. This means, D1 lymphadenectomy is enough for T1a cancer that is out of indication of EMR/ESD. This meets the criterion of the treatment guidelines for gastric cancer in Japan (3rd edition). However, most T1a cancer were negative for lymph node metastasis (667 out of 678: 98.4% in this study). Further studies are necessary to determine the condition for N0. For 82 cases of lymph node metastasis positive T1b cases, 77 cases (93.9%) were within D1+ range. One case did not meet the criterion of the guideline. This case was differentiated type, which size was smaller than 1.5 cm, but had cancer positive lymph node at No.8a which is out of D1 range (within D1+ range). Can we ignore this case? The operation of this case was distal gastrectomy and the difference between D1 and D1+ is the resection of No.8a and 9. Concerning surgical technique, as the difference between D1 and D1+ is not significant, we conclude that D1+ is reasonable for T1b cancer.

There were 5 cases (1.1%) which had cancer positive lymph node further than D1+. Two cases had No.12a metastasis. These cases also had multiple cancer positive lymph nodes at No.3. Thus, if the cancer is adjacent to the lesser curvature, undifferentiated type, and is larger than 4 cm in size, surgeons should examine the No.3 lymph nodes by pathological diagnosis during surgery. If No.3 lymph node metastasis is positive, No.12a lymph node should be resected to achieve D2. These cases require D2 lymphadenectomy. However, though one of these cases earned long term recurrence free survival (19 years after surgery), in another case life threatening lymph node recurrence occurred after one year. The question, whether D2 lymphadenectomy is necessary or not, still remains. Three cases had cancer positive lymph node further than D2. One case had No.16 lymph node metastasis. This case was suspected for No.16 lymph node metastasis by preoperative examination and was confirmed by resection of this lymph node. Multiple bone metastasis appeared, and this patient died after 4 years. Similar to the StageIV case in this study, there are some cases that cannot be cured by surgery alone among T1b cases. Two cases had lymph node metastasis at No.14v. In both of these cases, the tumor was at the L area and adjacent to the greater curvature and they had multiple cancer positive No.6 lymph nodes. Thus, these cases require No.6 lymph node by pathological diagnosis during surgery. When No.6 lymph node is cancer positive, No.14v resection should be performed. However, multiple bone metastasis appeared 5 years after operation in one case, and another case died of chronic heart failure and hemiplegia after cerebral infarction. The effect of lymphadenectomy further than D2 is not clear. However, as nearly 5 year survival was obtained in one case, there is a possibility that No.14v resection might be effective.

Considering the results of this study, we concluded as follow. D1 is enough for T1a cancer which is out of indication of EMR/ESD. D1+ is reasonable for T1b cancer. These are good indication for laparoscopic gastrecto-

my. D2 is required when the tumor exists adjacent to the lesser curvature, is undifferentiated type, is larger than 4 cm in size. Pathological diagnosis of No.3 lymph node should be performed during surgery in this case. No.14v resection might be effective in case, when the tumor is adjacent to the greater curvature of L area and also when No.6 lymph node metastasis is confirmed during surgery.

## References

- [1] Bonenkamp, J.J., Hermans, J., Sasako, M., van de Velde, C.J., Welvaart, K., Songun, I., Meyer, S., Plukker, J.T., Van Elk, P., Obertop, H., Gouma, D.J., van Lanschot, J.J., Taat, C.W., de Graaf, P.W., von Meyenfeldt, M.F. and Tilanus, H. (1999) Extended Lymph-Node Dissection for Gastric Cancer. *The New England Journal of Medicine*, **340**, 908-914. <http://dx.doi.org/10.1056/NEJM199903253401202>
- [2] Songun, I., Putter, H., Kranenbarg, E.M., Sasako, M. and van de Velde, C.J. (2010) Surgical Treatment of Gastric Cancer: 15-Year Follow-Up Results of the Randomised Nationwide Dutch D1D2 Trial. *The Lancet Oncology*, **11**, 439-449. [http://dx.doi.org/10.1016/S1470-2045\(10\)70070-X](http://dx.doi.org/10.1016/S1470-2045(10)70070-X)
- [3] Tsujinaka, T., Sasako, M., Yamamoto, S., Sano, T., Kurokawa, Y., Nashimoto, A., Kurita, A., Katai, H., Shimizu, T., Furukawa, H., Inoue, S., Hiratsuka, M., Kinoshita, T., Arai, K. and Yamamura, Y. (2007) Influence of Overweight on Surgical Complications for Gastric Cancer: Results from a Randomized Control Trial Comparing D2 and Extended Para-Aortic D3 Lymphadenectomy (JCOG9501). *Annals of Surgical Oncology*, **14**, 355-361. <http://dx.doi.org/10.1245/s10434-006-9209-3>
- [4] de Steur, W.O., Dikken, J.L. and Hartgrink, H.H. (2013) Lymph Node Dissection in Resectable Advanced Gastric Cancer. *Digestive Surgery*, **30**, 96-103. <http://dx.doi.org/10.1159/000350873>
- [5] Strong, V.E. and Yoon, S.S. (2013) Extended Lymphadenectomy in Gastric Cancer Is Debatable. *World Journal of Surgery*, **37**, 1773-1777. <http://dx.doi.org/10.1007/s00268-013-2070-1>
- [6] Japanese Gastric Cancer Association (2010) Treatment Guidelines for Gastric Cancer in Japan. 3rd Edition, Tokyo, Kanehara.
- [7] Yoshikawa, T., Tsuburaya, A., Kobayashi, O., Sairenji, M., Motohashi, H. and Noguchi, Y. (2002) Is D2 Lymph Node Dissection Necessary for Early Gastric Cancer? *Annals of Surgical Oncology*, **9**, 401-405. <http://dx.doi.org/10.1007/BF02573876>
- [8] Symeonidis, D., Koukoulis, G. and Tepetes, K. (2014) Sentinel Node Navigation Surgery in Gastric Cancer: Current status. *World Journal of Gastrointestinal Surgery*, **6**, 88-93.
- [9] Miyashiro, I., Hiratsuka, M., Sasako, M., Sano, T., Mizusawa, J., Nakamura, K., Nashimoto, A., Tsuburaya, A. and Fukushima, N. (2014) High False-Negative Proportion of Intraoperative Histological Examination as a Serious Problem for Clinical Application of Sentinel Node Biopsy for Early Gastric Cancer: Final Results of the Japan Clinical Oncology Group Multicenter Trial JCOG0302. *Gastric Cancer*, **17**, 316-323. <http://dx.doi.org/10.1007/s10120-013-0285-3>