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## Abstract

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# SURGICAL TREATMENT OF GASTRIC CANCER WITH SPECIAL REFERENCE TO LYMPH NODE REMOVAL

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*Abstract.* Factors influencing the prognosis in gastric cancer treated by curative resection include lymph node metastasis and the extent of invasion of the gastric wall. Lymph node metastasis can be removed surgically, but the extent of invasion is not amenable to external measures. Of these two factors, the extent of wall invasion has the greatest influence on prognosis in cases undergoing curative resection. With lymph node removal of equal extent the prognosis worsens in proportion to the depth of invasion. Further, lymph node metastasis increases with increasing depth of invasion. Metastasis was seen in Group 2 and 3 nodes in more than 60% of cancer with invasion beyond the Tunica muscularis propria (pm), indicating that wide lymph node removal is essential in cancers with deep invasion of the wall. The effects of extended radical operation on the host as illustrated by the indices of total serum protein and albumin levels were no different from those of less extensive resections. It was confirmed that extensive radical resection did not delay postoperative recovery.

The recent improvement in the prognosis of gastric cancer following curative resection is attributed to factors such as: 1. the improved detection of early gastric cancer, 2. the establishment of a procedure for the satisfactory removal of lymph nodes and the fact that this can now be carried out safely, and 3. the institution of combined chemotherapy where appropriate. In our department also, the frequency of early gastric cancer increased progressively from 1955 until 1965, at which time such cases comprised 20% of all cases undergoing curative resection. Since then, however, the frequency has levelled off and, even now, remains unchanged at approximately 20%. Although any further increase in the frequency of early gastric cancer resulting from improved diagnostic techniques would be welcome, the fact is that 80% of the cases of curative resection performed in this department are, as before, cases of advanced cancer. One of the objectives of the surgical treatment of such advanced cancer is extensive radical resection with due attention to the removal of lymph nodes.

In this paper, the surgical treatment of gastric carcinoma, especially where curative resection is involved, is discussed in terms of prognosis, extent of lymph

node metastasis and removal, and the depth of gastric wall invasion by comparison with the lymph nodes removed.

## CLINICAL OBSERVATION

*Cases studied*

The 282 cases analysed comprised those patients undergoing curative surgery for gastric cancer in our department who survived more than 5 years postoperatively, and in whom adequate histological examination of the lymph nodes had been performed.

*Lymph node metastasis*

The evaluation of lymph node metastasis at operation has to rely on macroscopic assessment (N), and it is imperative to decide, at operation, whether to perform a curative or a non-curative resection. The relation between macroscopic (N) and histological (n) criteria, therefore, is shown in Table 1. The criteria of N and n were described in accordance with the General Rules for the Gastric Cancer Study in Surgery (1) (Table 2, Fig. 1). Cases in which the macroscopic criteria agreed with the histological criteria (designated as N=n were the most frequent at 40.8% (115 cases). Those in which the macroscopic criteria overestimated the situation (N>n) comprised 29.8% (84 cases), and those where the macroscopic criteria under-estimated the situation (N<n), 29.4% (83 cases). These last two categories occurred at similar frequencies. Although the N=n

TABLE 1. FREQUENCY OF N AND n CLASSIFICATION

| | $N^a(-)$ | $N_1(+)$ | $N_2(+)$ | $N_3(+)$ | $N_4(+)$ | Total |
|---|---|---|---|---|---|---|
| $n^b(-)$ | 34[c] (45.3)[d] (69.4)[e] | 18 (24.0) (34.0) | 20 (26.7) (15.9) | 3 (4.0) (5.9) | | 75 (100) (22.6) |
| $n_1(+)$ | 9 (18.0) (18.4) | 13 (26.0) (24.5) | 20 (40.0) (15.9) | 7 (14.0) (13.7) | 1 (2.0) (33.3) | 50 (100) (17.7) |
| $n_2(+)$ | 3 (4.5) (6.1) | 10 (14.9) (18.9) | 40 (59.7) (31.7) | 13 (19.4) (25.5) | 1 (1.5) (33.3) | 67 (100) (23.8) |
| $n_3(+)$ | 3 (3.3) (6.1) | 12 (13.3) (22.6) | 46 (51.1) (36.5) | 28 (31.1) (54.9) | 1 (1.1) (33.3) | 90 (100) (31.9) |
| Total | 49 (17.4) (100) | 53 (18.8) (100) | 126 (44.7) (100) | 51 (18.1) (100) | 3 (1.1) (100) | 282 (100) |

*a, b* Grading of N (macroscopic criteria) and n (histological criteria) was according to the General Rules for the Gastric Cancer Study in Surgery (1).

*c, d, e* These numbers indicate as follows;
(*c*) case numbers, (*d*) percentage of the total cases in the grade of n, (*e*) percentage of the total cases in the grade of N.

situation occurred most frequently, it nevertheless only reached a 40% level of accuracy indicating the difficulties of macroscopic diagnosis and the necessity for practice. There is also the problem of minute metastatic deposits limiting the macroscopic diagnosis, that is, the group of N<n cases. There were 83 cases classified into this group, and, of those judged as N(−), $N_1$(+) and $N_2$(+), there were 61 cases of $n_3$(+) (73.5%). The most frequent were the 46 cases of $N_2$(+) $n_3$(+), but there were also 12 cases of $N_1$(+) $n_3$(+) and, though few, three cases of N(−) $n_3$(+) also occurred.

If determination of the extent of resection is based on macroscopic assessment at operation, 67.8% of the $n_3$(+) group would undergo non-curative surgery. This fact strongly suggests that the removal should be extensively performed without relying on the intraoperative macroscopic diagnosis.

An analysis of the n classification shows that $n_3$(+), at 31.9%, was most frequent, followed by n(−) 26.6%, $n_2$(+) 23.8%, and $n_1$(+) 17.7%. The

TABLE 2. COMPARISON OF THE NAME OF LYMPH NODE USED IN LYMPH NODE DISSECTION AND ANATOMIGAL NAME

| | |
|---|---|
| ① | Right cardiac lymph node |
| ② | Left cardiac lymph node |
| ③ | Lymph node along lesser curvature |
| ④ | Lymph node along greater curvature |
| ⑤ | Suprapyloric lymph node |
| ⑥ | Infrapyloric lymph node |
| ⑦ | Lymph node along left gastric artery |
| ⑧ | Lymph node along common hepatic artery |
| ⑨ | Lymph node around celiac artery: (Lymph node at the root of left gastric artery); (Lymph node at the root of common hepatric artery); (Lymph node at the root of splenic artery) |
| ⑩ | Lymph node at splenic hilus |
| ⑪ | Lymph node along splenic artery |
| ⑫ | Lymph node in hepatoduodenal ligament |
| ⑬ | Lymph node at posterior aspect of pancreas |
| ⑭ | Lymph node at the root of mesenterium |
| ⑮ | Lymph node around middle colic artery |
| ⑯ | Lymph node around abdominal aorta |

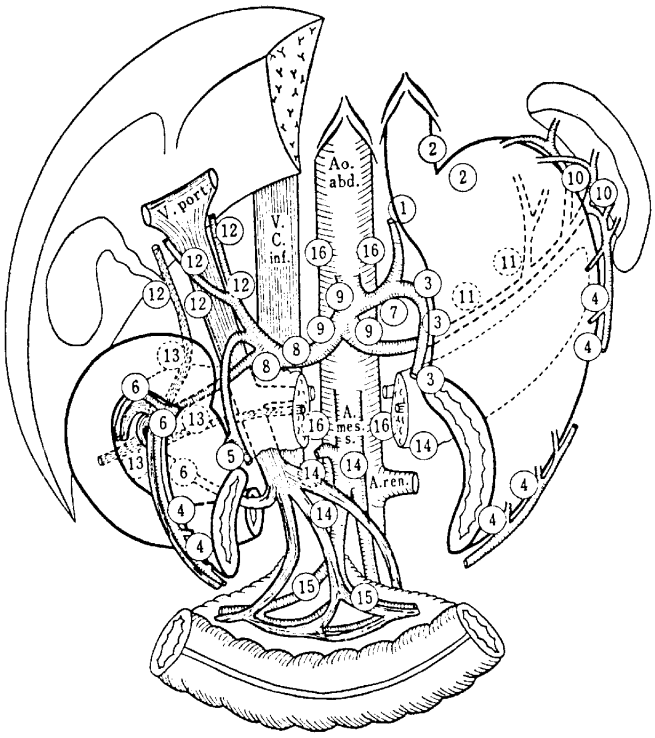


Fig. 1. Regional lymph node of the stomach: Numbers in the figure have been quoted in Table 2.

results for the 5-year survival rate of each of the n classifications show that it was highest in the n(−) group, at 73.3%, but that, even in the $n_3(+)$ group, it was 33.3%. These results bear out the significance of performing extended radical resection.

*Extent of lymph node removal*

Classification of the extent of lymph node removal was as follows: $R_1$ for removal of the first group of lymph nodes, $R_2$ for removal of the Group 1 and Group 2 nodes, and $R_3$ for removal of the Group 1, 2 and 3 nodes (the General Rules for the Gastric Cancer Study in Surgery (1)). In the author's department, extended radical resection is performed as a rule so that cases of $R_3$ are most frequent (62.4%) with fewer cases of $R_2$ and $R_1$, 28.4% and 9.2% respectively. These $R_2$ and $R_1$ groups include those cases where, although the intention was an $R_3$ or $R_2$ resection, inadequate lymph node removal resulted in the R number being lowered by one. They also include special cases such as early gastric cancer where extended removal was not necessary. Table 3 shows the correlation of extent of the lymph node removal with the degree of the lymph

TABLE 3. FREQUENCY OF R AND n CLASSIFICATION

| | $n^a$ (−) | $n_1$(+) | $n_2$(+) | $n_3$(+) | Total |
|---|---|---|---|---|---|
| $R^b_1$ | 23[c] (88.5)[d] (30.7)[e] | 3 (11.5) (6.0) | | | 26 (100) (9.2) |
| $R_2$ | 28 (35.0) (37.3) | 27 (33.8) (54.0) | 25 (31.3) (37.3) | | 80 (100) (28.4) |
| $R_3$ | 24 (13.6) (32.0) | 20 (11.4) (40.0) | 42 (23.8) (62.7) | 90 (51.9) (100) | 176 (100) (62.4) |
| Total | 75 (26.6) (100) | 50 (17.7) (100) | 67 (23.8) (100) | 90 (31.9) (100) | 282 (100) |

*a, b* Grades of n (histological criteria) and R (extent of lymph node removal) were determined according to the General Rules for the Gastric Cancer Study in Surgery (1).

*c, d, e* These numbers indicate as follows: (*c*) case numbers, (*d*) percentage of the total cases in the grade of R, (*e*) percentage of the total cases in the grade of n.

node metastasis. In a total of 176 cases of the $R_3$ resection group, 51.1% (90 cases) were $n_3(+)$, and 23.9% (42 cases) $n_2(+)$. But since 13.6% (24 cases) of the $R_3$ resected group were n(−), it would seem that an unduly aggressive treatment had been performed in those cases. In group $R_2$ resection, n(−), $n_1$ (+) and $n_2(+)$ were present in three equal groups with greater clustering to the n(−) side than in the $R_3$ group. This was markedly evident in group $R_1$, where 88.5% (23 cases) were n(−).

A comparison of the 5-year survival rate with the extent of lymph node removal showed that the prognosis worsened with the rise through the $R_1$, $R_2$ and $R_3$ groups. This was thought to be due to the above mentioned distribution of the n classification which was different depending on the R group; that is, the predominance of $n_3(+)$ in group $R_3$, and of n(−) in $R_1$, with group $R_2$ having an intermediate distribution was reflected in the differences in the 5-year survival rates. This means that the 5-year survival rate based on the R classification indicated the degree of lymph node metastasis. A more detailed analysis of the correlation of the 5-year survival to the extent of the removal and the degree of lymph node metastasis showed that even in the same $R_3$ resection group, the 5-year survival rate decreased from n(−) to $n_3(+)$ (Table 4). This suggests the relationship of the n-factor with the prognosis but even in the same n group, the 5-year survival rate decreases in proportion to the R number. For example, the 5-year survival rate of $n_1(+)$ in the $R_2$ group was 55.6%, while in the $R_3$ group, it was 40%. With $n_2(+)$, the 5-year survival rate in $R_2$ was 52% and 38.1% in $R_3$. Similar results were obtained in the n(−) group. The impression, therefore, is that the prognosis worsens with the more agressive operations.

TABLE 4. THE 5-YEAR SURVIVAL RATES OF THE R AND n CLASSIFICATION

| | n(−) | $n_1$(+) | $n_2$(+) | $n_3$(+) | Total |
|---|---|---|---|---|---|
| $R_1$ | 19[a]/23[b] (82.6)[c] | 3/3 (100) | | | 22/26 (84.6) |
| $R_2$ | 21/28 (75.0) | 15/27 (55.6) | 13/25 (52.0) | | 49/80 (61.3) |
| $R_3$ | 15/24 (62.5) | 8/20 (40.0) | 16/42 (38.1) | 30/90 (33.3) | 69/176 (39.2) |
| Total | 55/75 (73.3) | 26/50 (52.0) | 29/67 (43.3) | 30/90 (33.3)) | 140/282 (49.6) |

*a* Number of survival; *b* total number in the group; *c* percent survival.

TABLE 5. FREQUENCIES OF $s_0$ AND $s_1$ CATEGORIES IN THE R AND n CLASSIFICATION

| | n(−) | $n_1$(+) | $n_2$(+) | $n_3$(+) | Total |
|---|---|---|---|---|---|
| $R_1$ | m-$s_0$[a] 21(91.3)[b] / $s_1$∼ 2(8.7) } 23 | 3(100) } 3 | | | 24(52.3) / 2 (7.7) } 26(9.2) |
| $R_2$ | m-$s_0$ 17(60.7) / $s_1$∼ 11(39.3) } 28 | 10(37.0) / 17(63.0) } 27 | 10(40.0) / 15(60.0) } 25 | | 37(46.3) / 43(53.8) } 80(28.4) |
| $R_3$ | m-$s_0$ 13(54.2) / $s_1$∼ } 24 | 5(25.0) / 15(75.0) } 20 | 11(26.2) / 31(73.8) } 42 | 30(33.3) / 60(66.7) } 90 | 59(33.5) / 117(66.5) } 176(62.4) |

*a* m-$s_0$ and $s_1$ indicate degree of serosal invasion (see text).

*b* numbers in parentheses indicate percent incidence.

So far, the extent of removal and the degree of lymph node metastasis have been the only two factors taken into consideration. Table 5 shows the addition of s-factor to compare the freqency of serosal invasion with the R classification. The serosal invasion is divided into two groups: as far as the subserosal layer (m-$s_0$) and beyond the serosa ($s_1$∼). The frequency of $s_0$ for cases of n(−) was 91.3% in $R_1$ 60.7% in $R_2$ and 54.2% in $R_3$, which means that in the same category of n(−), the frequency of $s_0$ decreased as the R number increased, while the frequency of those with invasion beyond $s_1$ increased. The same was true of the $n_1$(+) and $n_2$(+) categories. This suggests that the greater the extent of resection was, the more numerous were the cases with serosal invasion. Originally, the decision as to the extent of removal (R) was based on the range of lymph node removal and was not related to the degree of serosal invasion. But since the degree of serosal invasion was shown to have a definite correlation with the extent of removal, the operator's attitude must be one which takes into account the degree of serosal invasion when dealing with the $n_2$(+) group of which $s_0$ occurred in 40% of $R_2$ and 26.2% of $R_3$. The $R_2$ resection group probably contains cases that were $s_0$ but in which an $R_3$ resection was not completed adequately. At any rate, for groups with the same degree of lymph node metas-

tasis, one reason why the 5-year survival rate decreases in line with increases in the R number is that there is an increase in the frequency of cases with seroral invasion beyond $s_1$.

As mentioned above, the 5-year survival rate of the R classification groups was an indication of the degree of metastasis to the lymph nodes, but with the same degree of lymph node metastasis, the 5-year survival rate depends on the degree of invasion of the wall, especially to the presence or absence of serosal invasion.

*Lymph node metastasis related to site*

The previous discussion of lymph node metastasis considered the Group 1, 2 and 3 nodes together as a combined lymph node group. The lymph nodes at each site, including each of the three lymph node groups, were further analysed in terms of the 5-year survival rates and frequency of metastasis. According to the General Rules for the Gastric Cancer Study in Surgery (1), lymph nodes around the stomach are classified from No. 1 to No. 15 (Fig. 1, Table 2). Each of these lymph nodes is further divided into three groups based on the site of the cancer. In Table 6, the rate of metastasis to each of these lymph nodes is compared to the site of the gastric cancer (A., M., C ).

In site A (lower gastric portion), a higher frequency of metastasis was observed to the lymph nodes of the first group; that is, to those of No. 3 (lesser curvature), No. 4 (greater curvature), No. 5 (suprapyloric), and No. 6 (infrapyloric). A high rate of metastasis also occurred to lymph nodes of the third group: No. 10 (splenic hilus), and No. 12 (intrahepatoduodenal ligament). This was approximately the same frequency as that the second group nodes of No. 1 (right cardia), No. 7 (along left gastric artery), No. 8 (along common hepatic artery) and No. 9 (along the coeliac artery). This trend was also noted in site M (middle gastric portion) and site C (upper gastric portion). One finding common to each of the sites was the high rate of metastasis to the third group of No. 12 lymph nodes (intrahepatoduodenal ligament).

The 5-year survival rates of cases with metastasis to these lymph nodes are shown in Table 7. The prognosis for site A (lower gastric portion) was poor when lymph node metastasis to No. 2 (left cardia) and No. 10 (splenic hilus) was found. On the other hand, the prognosis for metastasis to lymph node No. 12 (intrahepatoduodenal ligament), No. 13 (posterior aspect of pancreas) and No. 14 (root of mesenterium) was good even though they belonged to the Group 3 nodes. This was true provided complete removal was performed. In site M (middle gastric portion) lymph node removal gave an acceptable result, even though metastasis had already occurred to the Group 3 (No. 10 and No. 15) nodes. However, the 5-year survival rate with metastasis in cases of site C (upper gastric portion) and AMC (whole stomach) was extremely poor. This was considered

TABLE 6. RATE OF METASTASIS IN RELATION TO EACH GROUP OF LYMPH NODES AND SITE OF GASTRIC CANGER

| Site of gastric cancer | Number of cases | Percent metastasis[b] — Anatomical number of lymph nodes[c] | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| A | 124 | 40.0 | 19.4 | 69.2 | 59.8 | 50.8 | 74.7 | 36.7 | 54.3 | 47.6 | 44.0 | 24.2 | 40.2 | 28.0 | 23.8 | 29.3 |
| M | 78 | 50.0 | 25.0 | 70.4 | 55.4 | 51.7 | 44.9 | 45.8 | 42.9 | 31.7 | 52.0 | 25.0 | 24.6 | 23.1 | 23.7 | 14.8 |
| C | 21 | 71.4 | 66.7 | 82.4 | 53.3 | 100 | 40.0 | 87.5 | 46.2 | 62.5 | 41.7 | 40.0 | 42.9 | 16.7 | 16.7 | 16.7 |
| AMC | 18 | 33.3 | 0 | 66.7 | 37.5 | 60.0 | 100 | 100 | 40.0 | 33.3 | 66.7 | 100 | 57.1 | | 50.0 | |

*a* The sites of gastric cancer were classified as lower gastric portion (A), middle gastric portion (M), upper gastric portion (C) and whole stomach (AMC).

*b* (Number of cases with metastasis/number of cases with lymph node-removal) ×100.

*c* Anatomical number of lymph node is shown in Table 2 and Fig. 1.

TABLE 7. FIVE YEAR SURVIVAL RATES IN RELATION TO METASTASIS IN EACH LYMPH NODE GROUP

| Site of gastric cancer[a] | Number of cases | Percent survival[b] — Anatomical number of lymph nodes[c] | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| A | 124 | 30.0 | 0 | 32.4 | 35.8 | 40.6 | 33.8 | 18.2 | 39.2 | 16.7 | 9.1 | 12.5 | 24.3 | 57.1 | 33.3 | 16.7 |
| M | 78 | 50.0 | 60.0 | 40.0 | 46.3 | 40.0 | 50.0 | 36.4 | 41.7 | 46.2 | 61.5 | 85.7 | 35.7 | 66.7 | 44.4 | 75.0 |
| C | 21 | 10.0 | 0 | 14.3 | 25.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| AMC | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*a* The sites of gastric cancer were classified as lower gastric portion (A), middle gastric portion (M), upper gastric portion (C) and whole stomach (AMC).

*b* (Number of 5-year survival cases/number of cases with metastasis) ×100.

*c* Anatomical number of lymph node is shown in Table 2 and Fig. 1.

TABLE 8. RATE OF METASTASIS IN EACH GROUP OF LYMPH NODES IN RELATION TO HISTOLOGICAL CLASSIFICATION

| Histological type | Number of cases | Percent merastasis[a] Antomical number of lymph nodes 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Differentiated types | 104 | 60.5 | 18.8 | 70.8 | 61.1 | 34.3 | 64.5 | 37.9 | 48.7 | 44.9 | 53.1 | 3.4 | 37.8 | 25.0 | 23.1 | 22.9 |
| Undifferentiated types | 127 | 33.6 | 28.6 | 70.5 | 53.8 | 62.5 | 63.9 | 55.9 | 50.0 | 43.9 | 42.4 | 29.5 | 34.4 | 25.0 | 24.6 | 20.9 |

*a* (Number of cases with metastasis/number of cases with lymph node-removal) ×100

TABLE 9. FIVE YEAR SURVIVAL RATE OF PATIENTS IN RELATION TO METASTASIS IN EACH GROUP OF LYMPH NODE

| Histological type | Number of cases | Percent survival[a] Anatomical number of lymph nodes 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Differentiated type | 104 | 34.8 | 33.3 | 39.7 | 47.3 | 41.7 | 47.5 | 27.3 | 43.2 | 31.8 | 41.2 | 50.0 | 39.3 | 80.0 | 58.3 | 37.5 |
| Undifferentiated type | 127 | 27.3 | 12.5 | 26.6 | 29.7 | 35.0 | 26.4 | 15.8 | 30.4 | 13.8 | 14.3 | 23.1 | 9.1 | 33.3 | 14.3 | 22.2 |

*a* (Number of 5-year survival cases/number of cases with metastasis) ×100

to be due to the high incidence of advanced cancer in which the invasion extended beyond the limits of curative resection. The 5-year suvival rate of advanced cancer in site A was 41.9% (52/124), 51.3% (40/78) in site M, 28.6% (6/21) in site C, and 0% (0/8) in the overall AMC.

The histological classification was divided into differentiated and undifferentiated types. There was no difference in the rate of metastasis between the two types (Table 8), but the 5-year survival rate of cases with metastasis was better in the differentiated type, no matter which lymph nodes were involved by metastasis (Table 9). In other words, both types had similar rates of metastasis to lymph nodes but the 5-year survival rate was much better for the differentiated type than for the undifferentiated type. The histology showed that 50% (52/104) was of the differentiated type and 36.2% (46/127) of the undifferentiated type of advanced cancer.

*Macroscopic classification of the primary lesion*

A comparison of the frequency of the different R groups with the macroscopic classification of the primary lesion showed that more than 70% of type II, III, and IV (corresponding to Borrmann's classification) underwent the $R_3$ resection while a high rate of $R_1$ and $R_2$ resections was performed for types 0 and I (Table 10). Similar results were obtained from a comparison of the macroscopic classification with the degree of lymph node metastasis. In types II, III, and IV, $n_2(+)$ and $n_3(+)$ were most frequent, whereas in types 0 and I, $n(-)$ and $n_1(+)$ had the higher incidence (Table 11). In type IV, $n_3(+)$ had a much higher

TABLE 10. FREQUENCY OF MACROSCOPIC CLASSIFICATION[a] AND R CLASSIFICATION[b]

| | 0 | I | II | III | IV | Total |
|---|---|---|---|---|---|---|
| $R_1$ | 20[c]<br>(79.6)[d]<br>(51.3)[e] | 4<br>(15.4)<br>(33.3) | 2<br>(7.7)<br>(2.2) | 0 | 0 | 26<br>(100)<br>(9.2) |
| $R_2$ | 14<br>(17.5)<br>(35.9) | 5<br>(6.3)<br>(41.7) | 22<br>(27.5)<br>(24.4) | 33<br>(41.3)<br>(31.4) | 6<br>(7.5)<br>(16.7) | 80<br>(100)<br>(28.4) |
| $R_3$ | 5<br>(2.8)<br>(12.8) | 3<br>(1.7)<br>(25.0) | 66<br>(37.5)<br>(73.3) | 72<br>(40.9)<br>(68.6) | 30<br>(17.0)<br>(83.3) | 176<br>(100)<br>(62.4) |
| Total | 39<br>(13.8)<br>(100) | 12<br>(4.3)<br>(100) | 90<br>(31.9)<br>(100) | 105<br>(37.2)<br>(100) | 36<br>(12.8)<br>(100) | 282<br>(100) |

*a* Gastric cancers were classified into Type 0 (superficial carcinoma) and Types I, II, III and IV according to Borrmann's classification.

*b* The extent of lymph node removal was classified into $R_1$, $R_2$ and $R_3$ (see text).

*c* case numbers.

*d* Percent incidence in the group of R classification.

*e* Percent incidence in the group of macroscopic classification.

TABLE 11. FREQUENCY OF MACROSCOPIC CLASSIFICATION[a] AND LYMPH NODE METASTASIS[b]

| | 0 | I | II | III | IV | Total |
|---|---|---|---|---|---|---|
| n(−) | 30[c] (40.0)[d] (76.9)[e] | 5 (6.7) (41.7) | 18 (24.0) (20.0) | 11 (14.7) (10.5) | 11 (14.7) (30.6) | 75 (100) (26.6) |
| $n_1(+)$ | 6 (12.0) (15.0) | 3 (6.0) (25.0) | 13 (26.0) (14.4) | 26 (52.0) (24.8) | 2 (4.0) (5.6) | 50 (100) (17.7) |
| $n_2(+)$ | 3 (4.5) (7.7) | 2 (3.0) (16.7) | 24 (35.8) (26.7) | 30 (44.8) (28.6) | 8 (11.9) (22.2) | 67 (100) (23.8) |
| $n_3(+)$ | | 2 (2.2) (16.7) | 35 (38.9) (38.9) | 38 (42.2) (36.2) | 15 (16.7) (41.7) | 90 (100) (31.9) |
| Total | 39 (13.8) (100) | 12 (4.3) (100) | 90 (31.9) (100) | 105 (37.2) (100) | 36 (12.8) (100) | 282 (100) |

*a* Gastric cancers were classified into Type 0 (superficial carcinoma) and Types I, II, III and IV according to Borrmann's classification.
*b* The criteria of lymph node metastasis was described in accordance with the General Rules for the Gastric Cancer Study in Surgery (1) (Table 2, Fig. 1).
*c* Case numbers.
*d* Percent incidence in the group of classification.
*e* Percent incidence in the group of macroscopic classification.

frequency than any of the others, yet there was also a high rate of n(−), which gives some idea of the characteristic growth and advance of this type of cancer. Thus a knowledge of the value of the n factor in relation to macroscopic classfication enables the pre- and intra-operative assessment of the Borrmann type to be used as one index of the extent of lymph node removal necessary.

*Lymph node metastasis of early gastric cancer*

Of 210 cases of early gastric cancer in our department and affiliated hospitals, adequate histological investigation of lymph nodes was achieved in 131. The rate of metastasis in these 131 patients was 15% for mucosal infiltration (m) and 31% for submucosal infiltration (sm) (Table 12). Correlation with the n classifications showed that, for carcinoma with mucosal infiltration, the percentage of n(−) was 85%, $n_1(+)$ 11.7%, and $n_2(+)$ 1.7% and $n_3(+)$ 1.7%. For carcinoma with submucosal infiltration, the percentage of n(−) was 69%, $n_1(+)$

TABLE 12. RATE OF LYMPH NOTE METASTASIS OF EARLY GASTRIC CANCER

| Degree of infiltration | Percent metastasis in lymph nodes[a] | | | | Total |
|---|---|---|---|---|---|
| | n(−) | $n_1(+)$ | $n_2(+)$ | $n_3(+)$ | |
| Mucosal infiltration | 85.0(51/60) | 11.7(7/60) | 1.7(1/60) | 1.7(1/60) | 15.0 |
| Submucosal infiltration | 69.0(49/71) | 19.7(14/71) | 7.0(5/71) | 4.2(3/71) | 31.0 |

*a* The n classification is described in text.

19.7%, $n_2(+)$ 7%, and $n_3(+)$ 4.2%. Combination of the results for both these groups shows that there was a majority of cases with metastasis to the Group 1 lymph nodes, but that a definite number, though small, developed metastasis as far as the Group 3 lymph nodes, these cases were differentiated adenocarcinoma, type IIa in the antrum.

*Extent of lymph node removal and changes in the postoperative level of serum protein*

The levels of serum protein and albumin were used as indices of whether or not any differences related to the extent of lymph node removal occurred in the patient's postoperative recovery (Table 13). This table shows the total serum

TABLE 13. SERUM PROTEIN, ALBUMIN LEVEL AND R CLASSIFICATION

| Extent of lymph node removal | Post operative 1st week | | 2nd week | | 3rd week | |
|---|---|---|---|---|---|---|
| | Total protein[a] | Albumin[a] | Total protein | Albumin | Total protein | Albumin |
| $R_0$ | 5.9±0.1 | 2.7±0.1 | 6.3±0.1 | 2.6±0.1 | 6.6±0.2 | 3.0±0.1 |
| $R_1$ | 5.5±0.1 | 2.4±0.1 | 6.4±0.1 | 2.6±0.2 | 6.2±0.1 | 3.1±0.1 |
| $R_2$ | 5.7±1.1 | 2.1±0.2 | 6.0±0.1 | 2.5±0.0 | 6.3±0.3 | 3.0±0.1 |
| $R_3$ | 6.0±0.2 | 2.6±0.2 | 6.4±0.2 | 2.7±0.2 | 6.7±0.4 | 2.9±0.3 |

The number of cases were between 13 and 65.
*a* mean (g/100 ml) ±SD

protein and albumin levels in the first, second and third weeks after operation in relation to the extent of lymph node removal. Some of these cases comprise an $R_0$ group because non-curative operations were performed, but there were no significant differences among the R groups. Even the $R_3$ resection group had a minimal immediate postoperative fall in the serum protein and albumin levels, and this went on to increase daily. These indices, therefore, did not show any trend to delayed postoperative recovery following great surgical stress. One point for reference was that, based on the total serum protein and albumin levels, the age of the patient was an important factor related to delay in post-operative recovery (Table 14). Patients over 71 years old had a marked fall in serum protein

TABLE 14. SERUM PROTEIN, ALBUMIN LEVEL AND AGE

| Age group | Postoperative 1st week | | 2nd week | | 3rd week | |
|---|---|---|---|---|---|---|
| | Total protein[a] | Albumin[a] | Total protein | Albumin | Total protein | Albumin |
| ≦ 50 | 6.2±0.0 | 2.9±0.0 | 6.8±0.0 | 3.0±0.1 | 7.1±0.0 | 3.1±0.1 |
| 51-60 | 5.8±0.1 | 2.3±0.1 | 6.4±0.1 | 2.6±0.1 | 6.7±0.1 | 3.0±0.1 |
| 61-70 | 5.9±0.1 | 2.8±0.1 | 6.2±0.1 | 2.7±0.1 | 6.3±0.0 | 2.9±0.1 |
| ≧ 71 | 3.9±0.1 | 2.1±0.1 | 4.6±0.1 | 2.2±0.1 | 4.6±0.6 | 3.0±0.1 |

The number of cases were between 13 and 65.
*a* mean (g/100 ml) ± SD

levels with a delay in the post-operative increase.

## DISCUSSION AND CONCLUSION

Factors influencing the prognosis of gastric cancer in which curative resection has been achieved include the degree of cancer invasion of the gastric wall and the extent of lymph node metastasis (2). One of the limiting conditions of the curative resection is the relation of extent of lymph node removal to the degree of lymph node metastasis. If lymph node metastasis is only as far as Group 3, this factor can be altered surgically. However, the degree of invasion of the gastric wall is an unalterable factor. Now that extended radical resection with widespread lymph node removal is an established and safe surgical procedure, it should be aggressively attempted in order to achieve a curative resection. The prognosis of the different extents of lymph node removal correlates with the extent of lymph node metastasis (3–6). In other words, even with resection of equal extent, the more extensive the lymph node metastasis is, the lower the 5-year survival rate is.

To quote an extreme example, even in cases without lymph node metastasis, the prognosis of $R_3$ was worse than that of R . It would appear that this was due to the added stress of the surgical resection but, in fact, the degree of invasion of the wall was principally responsible, since many of the cases in which widespread lymph node removal was performed proved to have serosal invasion (2, 3, 7, 8). There is essentially no relation between the extent of lymph node removal and serosal invasion, but I have mentioned previously that the prognosis of those with serosal invasion is poor, (2, 3), so the depth of invasion of the wall clearly influences the prognosis as based on the extent of lymph node removal. But a difference was observed in the prognosis of the cases with serosal invasion. The groups $s_0$ and $s_1$ had similarly good prognoses, whereas the prognosis of $s_2$ was poor. Thus, serosal invasion has a decisive influence on the postoperative prognosis, judging from cases in which adequate lymph node removal was achieved. If lymph node removal could not be performed, it would not be possible to discuss, simply, the influence of the degree of invasion because the prognosis would be worse due to the remaining lymph node metastasis.

There was a tendency of increasing metastasis to lymph nodes with increase in infiltration of the wall. In the present series, over 60% of gastric carcinoma with infiltration beyond the layer of tunica muscularis ventriculi involved metastasis to the Group 2 and 3 lymph nodes. To achieve a curative resection for gastric carcinoma, therefore, an extended resection is essential.

The effect of extended curative resection on postoperative recovery was studied using, as indicators, the total serum protein and albumin levels. No significant differences due to different extent of removal were demonstrated and

widespread lymph node removal caused no appreciable delay in postoperative recovery.

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