Comparison of incidence and prognosis between young and old gastric cancer patient in North-Western China
A retrospective cohort study

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Abstract
Gastric cancer (GC) is the fourth most common cancer in the world and the second most common cancer in China. In this study, we compared the clinicopathological features and prognosis of GC between young and old patients after curative resection. Six hundred and eighty-six patients with GC resected were divided two groups according to patient age: Younger GC patients ≤40 years of age (YGC, n = 52) and older GC patients >40 years of age (OGC, n = 634). The YGC group had 52 (7.6%) patients in total 686 GC patients. YGC patients was predominant in women (53.8% vs 26.5%) compared with OGC patients. 5-year overall survival exhibited differences in tumor sites, tumor sizes, macroscopic types, T staging, N staging, rate of N staging (rN), tumor node metastasis staging, scope of gastrectomy, radical degree, and lymphatic vascular invasion within each of YGC and OGC group. Univariate analysis of the clinical factors affecting overall survival in YGC group revealed the significant differences in tumor size, macroscopic types (except Borrmann), T staging (except T2), N staging (N3a and N3b), rN, tumor node metastasis staging (III), scope of gastrectomy, radical degree, and lymphatic vascular invasion. Gender, N staging, rN, radical degrees were the independent prognostic factors of younger patients with GC. Similar results were found in the OGC groups. The significant differences in radical degree and lymphatic vascular invasion were found between male and female patients in YGC group. Similar results were found in the OGC groups. Our results showed that YGC patients differ from OGC patients in predominance of women. Gender, N staging, rN, radical degrees were independent risk factors for the prognosis in YGC patients.

Abbreviations: 95% CI = 95% confidence interval, GC = gastric cancer, HR = hazards ratio, OGC = older gastric cancer, OS = overall survival, YGC = younger gastric cancer.

Keywords: clinicopathologic profiles, gastric cancer, prognosis, young patients

1. Introduction
According to data from the Global Cancer Epidemiology Database in 2018, gastric cancer (GC) has the global incidence of 5.7% and the mortality rate of 8.2%, becoming the fifth most common cancer in the world and the third leading cause of cancer deaths.[1] GC is the second most common cancer in China, having different incidences in different geographic regions.[2] GC is found both in middle- or aged- patients and in younger age groups.[2–6] Zhou et al.[6] compared the young to old GC patients (≤40 vs ≥41 years) in Eastern China and found that the young GC was predominantly shown in women. Qiu et al.[3] compared the clinicopathological characteristics between young (20 and 50 years old) and elder (51 years of age or over) GC patients in Southern China and found that the former differs from that of the late including more aggressive histologic features, a lack of male predilection, and better survival rate. However, few studies reported the comparison between the young and elder GC patients in North-Western China.

Qinghai Province is located in the North-Western China and one of the provinces having the highest incidence and mortality of GC in China.[3] We previously analyzed the clinicopathologic characteristics and prognosis of GC patients with different tumor locations in Qinghai Province and found that GC in upper third of the stomach is distinct from the lower third GC.

This study was supported by Key R&D and Transformation Program of Qinghai Province-Special Project of Science and Technology Assistance (no. 2021-QY-213), Applied Basic Research of Qinghai (no. 2018-ZJ-744), the CAS (Light of the West China) Program (no. 2019-33), the Open Project of State Key Laboratory of Plateau Ecology and Agriculture, Qinghai University (no. 2019-ZZ-07), and Team Project of Qinghai University Medical College (no. 2020-KYT-2).

The authors have no conflicts of interest to disclose.

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

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How to cite this article: An J, Ma X, Zhang C, Zhou W, Wang C, Miao W, Cai B, Yu P, Qiao W, Xu Z. Comparison of incidence and prognosis between young and old gastric cancer patient in North-Western China: A retrospective cohort study. Medicine 2022;101:42(e31255).

Received: 28 January 2022 / Received in final form: 16 September 2022 / Accepted: 19 September 2022.

http://dx.doi.org/10.1097/MD.0000000000031255
whereas middle third GC shares some characteristics from both upper third GC and lower third GC. However, few studies reported the incidence and prognosis of young GC in the province. The present study was designed to compare the clinico-pathologic characteristics and prognosis of GC in patients ≤40 and >40 years of age.

2. Materials and Methods

2.1. Patients

A total of 686 GC patients resected from January 2010 to January 2015 were divided two groups according to patient age: younger GC patients ≤40 years of age (YGC, \( n = 52 \)) and older GC patients >40 years of age (OGC, \( n = 634 \)). Demographic and clinical data including age, sex, tumor size, macroscopic types, histological types, depth of invasion, lymph node metastasis, lymph embolism and tumor location were analyzed according to Guidelines of the Japanese Gastric Cancer Association. International Union Against Cancer tumor node metastasis (TNM) classification system was used to evaluate lymph node metastasis. Preoperative evaluation included endoscopic examination with biopsy and computed tomography. This study was approved by the Review Board of the Affiliated Hospital of Qinghai University (Approval ID number: 20190515). Written informed consent was obtained from each participant.

2.2. Operative procedures

D2 gastrectomy and radical resection was conducted for all patients by surgeons with over 10 years of experiences.

2.3. Follow-up

As of January 31, 2020, the percentage of follow-up was 95.5% (655/686).

2.4. Statistical analysis

SPSS 22.0 (SPSS Inc., Chicago, IL) was used to do the statistical analyses. Categorical variables were analyzed by Pearson \( \chi^2 \) test. Kaplan–Meier analysis was used for the survival and univariate analysis. The Cox proportional hazards regression model was applied to perform multivariate analysis. Risk and 95% confidence interval (95% CI) were calculated. It was considered statistically significant when \( P \) value < .05.

3. Results

3.1 Clinicopathological features in YGC and OGC groups

As shown in Table 1, there were 52 (7.6%) patients in YGC group in a total of 686 patients with GC (Table 1). The average ages of GC patients were 34.9 ± 6.3 years and 60.5 ± 9.8 years in YGC and OGC group respectively. In YGC group, there were 28 (53.8%) women, more than 168 (26.5%) in OGC group. The significant differences in macroscopic types (\( P = .006 \), T staging (\( P = .004 \)) and differentiation degree (\( P = .026 \)) were found between the two groups. With regards to macroscopic types, the percentage of early gastric carcinoma (EGC) in YGC group was higher than that in OGC group (32.7% vs 13.7%), while that of BOR3 in YGC group was lower (53.8% vs 67.0%). Regarding to T staging, the percentage of T1 in YGC group was higher than that in OGC group (32.4% vs 13.7%), while that of T2 and T4b in YGC group was lower (77.7% vs 14.5% for T2; 15.4% vs 25.7% for T4b). For differentiation degree, the percentage of H+M in YGC group was lower than that in OGC group (9.6% vs 22.9%), while that of L+non in YGC group was higher (90.4% vs 77.1%). However, no significant differences in family history of tumor, tumor sites, complications, tumor size, N staging, rate...

### Table 1

Comparison of clinicopathological features of GC patients in younger and older groups.

| Category                  | YGC, n (%) | OGC, n (%) | \( P \) value |
|---------------------------|------------|------------|--------------|
| Total                     | 52 (7.6)   | 634 (92.4) | <.001        |
| Age (yr)                  | 34.9 ± 6.3 | 60.5 ± 9.8 | P < .001     |
| Gender                    |            |            |              |
| Male                      | 24 (46.2)  | 466 (73.5) |              |
| Female                    | 28 (53.8)  | 168 (26.5) |              |
| Family history of tumor   |            |            | .638         |
| Yes                       | 8 (15.4)   | 114 (18.0) |              |
| No                        | 44 (84.6)  | 520 (82.0) |              |
| Tumor sites               |            |            | .132         |
| Upper third               | 1 (1.9)    | 75 (11.8)  |              |
| Middle third              | 10 (19.2)  | 98 (15.5)  |              |
| Lower third               | 38 (73.1)  | 440 (69.4) |              |
| Total stomach             | 3 (5.8)    | 21 (3.3)   |              |
| Complications             |            |            | .305         |
| Yes                       | 2 (3.8)    | 49 (7.7)   | .475         |
| No                        | 50 (96.2)  | 585 (92.3) |              |
| Tumor sizes (cm)          |            |            |              |
| ≦5                        | 38 (73.1)  | 357 (56.3) |              |
| >5                        | 14 (26.9)  | 277 (43.7) |              |
| Macroscopic types         |            |            | .006         |
| EGC                       | 17 (32.7)  | 87 (13.7)  |              |
| BOR1                      | 1 (1.9)    | 17 (2.7)   |              |
| BOR2                      | 2 (3.8)    | 44 (6.9)   |              |
| BOR3                      | 28 (53.8)  | 425 (67.0) |              |
| BOR4                      | 4 (7.7)    | 61 (9.6)   |              |
| T staging                 |            |            | .004         |
| T1                        | 17 (32.4)  | 87 (13.7)  |              |
| T2                        | 4 (7.7)    | 92 (14.5)  |              |
| T3                        | 16 (30.8)  | 215 (33.9) |              |
| T4a                       | 7 (13.5)   | 77 (12.1)  |              |
| T4b                       | 8 (15.4)   | 163 (25.7) |              |
| N staging                 |            |            | .130         |
| NO                        | 20 (38.5)  | 249 (39.3) |              |
| N1                        | 4 (7.7)    | 117 (18.5) |              |
| N2                        | 9 (17.3)   | 117 (18.5) |              |
| N3a                       | 13 (25.0)  | 115 (18.1) |              |
| N3b                       | 6 (11.5)   | 42 (6.1)   |              |
| N                          | 29 (55.8)  | 397 (62.6) | .591         |
| 1                         | 14 (26.9)  | 137 (21.6) |              |
| 2                         | 9 (17.3)   | 100 (15.8) |              |
| 3                         | 13 (25.0)  | 132 (20.8) |              |
| 4                         | 14 (26.9)  | 168 (26.5) |              |
| 5                         | 25 (48.1)  | 334 (52.7) |              |
| TNM staging               |            |            | .743         |
| I                         | 13 (25.0)  | 132 (20.8) |              |
| II                        | 14 (26.9)  | 168 (26.5) |              |
| III                       | 25 (48.1)  | 334 (52.7) |              |
| Scope of gastrectomy      |            |            | .789         |
| TG                        | 7 (13.5)   | 94 (14.8)  |              |
| NTG                       | 45 (86.5)  | 540 (85.2) |              |
| Radical degree            |            |            | .054         |
| Yes                       | 32 (61.5)  | 302 (47.6) |              |
| No                        | 20 (38.5)  | 332 (52.4) |              |
| Differentiation degree    |            |            | .026         |
| H+M                       | 5 (9.6)    | 145 (22.9) |              |
| L+non                     | 47 (90.4)  | 489 (77.1) |              |
| Lymphatic vascular invasion|   |            | .127         |
| Negative                  | 36 (69.2)  | 497 (78.4) |              |
| Positive                  | 16 (30.8)  | 137 (21.6) |              |
| Postoperative chemotherapy|   |            | .537         |
| Yes                       | 16 (30.8)  | 170 (26.8) |              |
| No                        | 36 (69.2)  | 464 (73.2) |              |
| 5-years OS (%)            | 49          | 46                      | .972         |

BOB = Borrmann, EGC = early gastric carcinoma, GC = gastric cancer, NTG = non total gastrectomy, OGC = older gastric cancer, OS = overall survival, \( rN \) = rate of N staging, TNM = tumor node metastasis, TG = total gastrectomy, YGC = younger gastric cancer.
of N staging (rN), TNM staging, scope of gastrectomy, radical degree, lymphatic vascular invasion, postoperative chemotherapy and 5-years overall survival (OS) were shown between two groups.

3.2 Comparison of 5-year OS in YGC and OGC groups

As shown in Table 2, Kaplan–Meier analysis showed that 5-year OS exhibited differences in tumor sites (Fig. 1A and B), tumor sizes (Fig. 1C and D), macroscopic types (Fig. 1E and F), stage (Fig. 1G and H), N stage (Fig. 1I and J), rN (Fig. 2A and B), TNM stage (Fig. 2C and D), scope of gastrectomy (Fig. 2E and F), radical degree (Fig. 2G and H), and lymphatic vascular invasion (Fig. 2I and J) within each of YGC (upper panel) and OGC (lower panel) group. Take tumor sizes as an example, the 5-year OS of upper third, middle third, lower third and total stomach in YGC group was 0%, 49%, 55%, and 0% (P = .037) respectively; while that in OGC was 17%, 43%, 50%, and 26% (P < .001) respectively. However, no significant differences in gender, family history of tumor, complications and postoperative chemotherapy were found in both each of group and between groups.

3.3. Univariate and multivariate analysis of OS in YGC group

Univariate analysis of the clinical factors affecting OS in YGC group revealed the significant differences in tumor size, macroscopic types (except Borrmann [BOR2]), T stage (except T2), N stage (N3a and N3b), rN, TNM stage (III), scope of gastrectomy, radical degree, and lymphatic vascular invasion (Table 3). Regarding tumor sizes, larger size was the risk factor for the poor prognosis of YGC patients (hazards ratio [HR] = 4.695, 95% CI = 2.139–10.307, P < .001). Comparing with EGC in macroscopic types, BOR1, BOR3 and BOR4 were the risk factors for the poor prognosis (HR = 146.041, 95% CI = 7.984–2671.190, P = .001 for BOR1; HR = 22.195, 95% CI = 2.970–165.864, P = .003 for BOR3; HR = 28.703, 95% CI = 2.935–280.705, P = .004 for BOR4 respectively). Multivariate analysis of OS in YGC group showed that gender (HR = 0.107, 95% CI = 0.015–0.769, P = .026), N stage (HR = 0.015, 95% CI = 0.000–0.092, P = .032 for N1; HR = 0.002, 95% CI = 0.000–0.455, P = .0026 for N2; HR = 0.000, 95% CI = 0.000–0.052, P = .004 for N3a), rN (2) (HR = 213.608, 95% CI = 3.781–12068, P = .009), radical degree (HR = 0.041, 95% CI = 0.003–0.671, P = .0250) were the independent prognostic factors of younger patients with GC.

3.4. Univariate and multivariate analysis of OS in OGC group

Univariate analysis of the clinical factors affecting OS in OGC group revealed the significant differences in tumor sites (except for total stomach), tumor size, macroscopic types, T stage, N stage, rN, TNM stage, scope of gastrectomy, radical degree, differentiation degree and lymphatic vascular invasion (Table 4). Regarding tumor sites, middle third and lower third were the risk factors for the poor prognosis of YGC patients (HR = 0.686, 95% CI = 0.472–0.997, P = .048 for middle third; HR = 0.544, 95% CI = 0.404–0.734, P < .001 for lower third). Comparing with EGC in macroscopic types, BOR1, BOR2, BOR3 and BOR4 were the risk factors for the poor prognosis (HR = 0.609, 95% CI = 2.137–18.844, P < .001 for BOR1; HR = 5.377, 95% CI = 2.230–12.967, P < .001 for BOR2; HR = 11.766, 95% CI = 5.551–24.939, P < .001 for BOR3; HR = 20.114, 95% CI = 9.078–44.568, P < .001 for BOR4 respectively). Multivariate analysis of OS in OGC group showed that tumor sizes (HR = 0.638, 95% CI = 0.461–0.882, P = .007 for lower third; HR = 0.383, 95% CI = 0.194–0.754, P = .006 for total stomach), macroscopic types (HR = 0.424, 95% CI = 0.185–0.970, P = .042 for BOR2; HR = 0.486, 95% CI = 0.238–1.002, P = .053 for BOR3), TNM stage (HR = 0.107, 95% CI = 0.015–0.769, P < .001), and lymphatic vascular invasion (HR = 0.107, 95% CI = 0.015–0.769, P = .026) were the independent prognostic factors for the poor prognosis of older patients with GC.

### Table 2

Comparison of 5-year OS of GC patients in younger and older groups.

| Category                  | YGC (%) | P*   | OGC (%) | P*   | P** *
|---------------------------|---------|------|---------|------|------
| Gender                    |         |      |         |      |      
| Male                      | 49      | 45   | 75      | .439| .523 |
| Female                    | 50      | 47   | 55      | .439| .523 |
| Family history of tumor   |         |      |         |      |      
| Yes                       | 88      | 46   | 109     | .900| .575 |
| No                        | 42      | 46   | 42      | .900| .575 |
| Tumor sites               |         |      |         |      |      
| Upper third               | 0       | 17   | .037    | <.001| .003 |
| Middle third              | 49      | 43   |         |      |      
| Lower third               | 55      | 50   |         |      |      
| Total stomach             | 0       | 26   |         |      |      
| Complications             |         |      |         |      |      
| Yes                       | 100     | 43   | .224    | .512| .717 |
| No                        | 47      | 46   |         |      |      
| Tumor sizes (cm)          |         |      |         |      |      
| ≤5                        | 62      | 50   | .001    | <.001| <.001 |
| >5                        | 14      | 37   |         |      |      
| Macroporotic types        |         |      |         |      |      
| EGC                       | 100     | 94   | .001    | <.001| <.001 |
| BOR1                      | 0       | 57   |         |      |      
| BOR2                      | 50      | 62   |         |      |      
| BOR3                      | 25      | 37   |         |      |      
| BOR4                      | 0       | 23   |         |      |      
| N staging                 |         |      |         |      |      
| N0                        | 85      | 73   | <.001   | <.001| <.001 |
| N1                        | 50      | 44   |         |      |      
| N2                        | 67      | 33   |         |      |      
| N3a                       | 8       | 15   |         |      |      
| N3b                       | 0       | 8    |         |      |      
| rN                        |         |      |         |      |      
| 1                         | 79      | 63   | <.001   | <.001| <.001 |
| 2                         | 21      | 22   |         |      |      
| 3                         | 0       | 9    |         |      |      
| TMN staging               |         |      |         |      |      
| I                         | 100     | 87   | <.001   | <.001| <.001 |
| II                        | 78      | 58   |         |      |      
| III                       | 8       | 24   |         |      |      
| Scope of gastrectomy      |         |      |         |      |      
| TG                        | 14      | 23   | .006    | <.001| <.001 |
| NTG                       | 58      | 50   |         |      |      
| Radical degree            |         |      |         |      |      
| Yes                       | 65      | 64   | .005    | <.001| <.001 |
| No                        | 25      | 30   |         |      |      
| Differentiation degree    |         |      |         |      |      
| H+M                       | 60      | 54   | .564    | .004| .004 |
| L+non                     | 48      | 44   |         |      |      
| Lymphatic vascular invasion|       |      |         |      |      
| Negative                  | 60      | 52   | .005    | <.001| <.001 |
| Positive                  | 25      | 25   |         |      |      
| Postoperative chemotherapy |         |      |         |      |      
| Yes                       | 43      | 52   | .585    | .092| .141 |
| No                        | 52      | 45   |         |      |      

*Between groups.
95% CI = 0.269–0.875, \( P = .016 \) for BOR3; \( \text{HR} = 0.682, 95\% \text{CI} = 0.482–0.964, \ P = .030 \) for BOR4, respectively); \( \text{N} \) staging (N3b) (\( \text{HR} = 2.674, 95\% \text{CI} = 1.340–5.334, \ P = .005 \)), \( \text{rN} \) (\( \text{HR} = 1.684, 95\% \text{CI} = 1.158–2.451, \ P = .006 \) for \( \text{rN2} \); \( \text{HR} = 2.198, 95\% \text{CI} = 1.391–3.474, \ P = .001 \) for \( \text{rN3} \), radical degree (\( \text{HR} = 1.320, 95\% \text{CI} = 1.018–1.712, \ P = .036 \)), lymphatic vascular invasion (\( \text{HR} = 1.327, 95\% \text{CI} = 1.029–1.713, \ P = .030 \)) and postoperative chemotherapy (\( \text{HR} = 1.495, 95\% \text{CI} = 1.153–1.938, \ P = .002 \)) were the independent prognostic factors of older patients with GC.

3.5. Clinicopathological features of YGC between male and female

As shown in Table 5, the significant differences in radical degree and lymphatic vascular invasion were found between male and female patients in YGC group. Regarding radical degree, the percentage of Yes in male group was higher than that in female group (83.3% vs 42.9%), while that of No in male group was lower (16.7% vs 57.1%). For lymphatic vascular invasion, the percentage of Negative in male group was higher than that in female group (87.5% vs 53.6%), while that of Positive in male group was lower (12.5% vs 46.4%). However, no significant differences in other categories were shown between male and female patients in YGC group.

3.6. Clinicopathological features of OGC between male and female

As shown in Table 6, the significant differences in tumor sites were found between male and female patients in OGC group. The percentage of upper third in male group was higher than that in female group (14.6% vs 4.2%), while that of lower third in male was lower (67.4% vs 75.0%). However, no significant differences in other categories were shown between male and female patients in OGC group.

4. Discussion

In the previous study, we reported the clinicopathologic characteristics and prognosis of GC patients with different tumor locations in Qinghai Province located in the North-Western China, showing that upper third GC is distinct from the lower third GC whereas middle third GC shares some characteristics from both upper third GC and lower third GC.\(^{[10]}\) In the present study, we compared the age-specific clinicopathologic characteristics and prognosis of GC and found that young GC patients was predominant in women, EGC of macroscopic types, T1 of T staging and low or non-differentiation degree compared with old GC patients.

A number of studies reported that young GC patients aged 40 years or less account for 4.4% to 14.8% of all patients with GC.\(^{[6,13–18]}\) The present study demonstrated that there were 7.6% patients in YGC group age 40 years or younger in a total of 686 patients with GC, which is within the range of the literature. Taken together, these results suggested the similarity in the percentages of younger GC regardless of the nation and region.

We found in the present study that there were 53.8% women in YGC group, more than 26.5% in percentage in OGC group. The results are in agreement with many studies. In the cohort conducted by Lawniczak et al.,\(^{[19]}\) the authors found that in the GC patient group aged 40 years of age or less, female patients predominated with comparison of the older group (60% vs 32.4%). The differences in sex ratio might be explained by the

Figure 1.

Kaplan–Meier curve of OS for tumor sites (A and B), macroscopic types (E and F), T staging (G and H) and N staging (I and J) in YGC (upper panel) and OGC (lower panel) groups. OGC = older gastric cancer, OS = overall survival, YGC = younger gastric cancer.

Figure 2.

Kaplan–Meier curve of OS for rN (A and B), TNM staging (C and D), scope of gastrectomy (E and F), radical degree (G and H) and lymphatic vascular invasion (I and J) in YGC (upper panel) and OGC (lower panel) groups. OGC = older gastric cancer, OS = overall survival, rN = rate of N staging, TNM = tumor node metastasis, YGC = younger gastric cancer.
hormonal factors. After analyzing 3242 younger GC patients in South Korea, Chung et al.[4] concluded that among the female, older age (>35 years) at first delivery, lack of lactation history, and poor nutrition in pregnancy were significantly associated with the increase in risk of GC.

The present study revealed the significant differences in macroscopic types, T staging and differentiation degree between YGC and OGC groups. Regarding to differentiation degree, there were 90.4% low and non-degrees in YGC group, more than 77.1% in percentage in OGC group. Similarly, Several studies[8,9,13,14,20,21] reported that diffuse GC was more common for patients of 40 years of age or less comparing with the older patients, in consistent with the findings reported by several previous studies. However, no significant differences in family history of tumor, tumor sites, complications, tumor size, N staging, rN, TNM staging, scope of gastrectomy, radical degree, lymphatic vascular invasion, postoperative chemotherapy and 5-years OS were shown between two groups. With regard to family history of tumor between 40 years or less and 40-year-old groups (15.4% vs 18.0%) shown in the present study, there are in agreement with several studies. Kulig et al.[13] revealed a comparable percentage of positive family history for GC between younger and older patients in Poland. Similarly, Isobe et al.[6] found no differences between younger and older groups in family history of GC (5.9% vs 6.3%) after analyzing 3818 patients with GC in China. Regarding to 5-year OS, no difference was found between YGC and OGC groups (49% vs 46%), which is not consistent with the report by Qiu et al.[3] showing that the 5-year disease-specific survival rate for the young patients was higher than that of the elderly patients. The inconsistence might be explained by the different cutoff of ages because Qiu et al.[3] compared GC patients between 20 and 50 years old with elder patients 51 years of age or over, while in the present study the 40 ages was used as cutoff.

Kaplan–Meier analysis showed that 5-year OS exhibited differences in tumor sites, tumor sizes, macroscopic types, T staging, N staging, rN, TNM staging, scope of gastrectomy, radical degree, and lymphatic vascular invasion within each of YGC and OGC group. Take tumor sites as an example, the 5-year OS of upper third, middle third, lower third and total stomach in YGC group was 0%, 49%, 55% and 0% respectively; while that in OGC was 17%, 43%, 50% and 26% respectively. However, no significant differences in gender, family history of tumor, complications and postoperative chemotherapy were found in both each of group.

Table 3

Uni- and multivariate analyses (cox regression) on prognosis of YGC patients.

| Category                  | Univariate analysis | Multivariate analysis |
|---------------------------|---------------------|-----------------------|
|                           | HR (95% CI)         | P                     | HR (95% CI)         | P                     |
| Female                    | 1.129 (0.528–2.412) | .755                  | 0.107 (0.015–0.769) | .026                  |
| Positive family history   | 3.053 (0.719–12.962) | .130                  |                       |                       |
| Tumor sites               |                     |                       |                       |                       |
| Upper third               | Reference           |                       |                       |                       |
| Middle third              | 0.614 (0.071–5.290) | .657                  |                       |                       |
| Lower third               | 0.523 (0.069–3.950) | .530                  |                       |                       |
| Total stomach             | 2.866 (0.283–29.036) | .373                  |                       |                       |
| Complications             | 0.046 (0.000–93.259) | .427                  |                       |                       |
| Larger tumor sizes (cm)   | 4.695 (2.139–10.307) | <.001                 |                       |                       |
| Macroscopic types         |                     |                       |                       |                       |
| EGC                       | Reference           |                       |                       |                       |
| BOR1                      | 146.041 (7.984–2671.190) | .001              |                       |                       |
| BOR2                      | 12.611 (0.787–202.149) | .073                  |                       |                       |
| BOR3                      | 22.195 (2.970–165.864) | .003                  |                       |                       |
| BOR4                      | 28.703 (2.935–280.705) | .004                  |                       |                       |
| T staging                 |                     |                       |                       |                       |
| T1                        | Reference           |                       |                       |                       |
| T2                        | 9.580 (0.868–105.708) | .065                  |                       |                       |
| T3                        | 18.373 (2.343–144.054) | .006                 |                       |                       |
| T4a                       | 34.199 (4.049–288.881) | .001                 |                       |                       |
| T4b                       | 45.768 (5.568–376.174) | <.001                |                       |                       |
| N staging                 |                     |                       |                       |                       |
| N0                        | Reference           |                       |                       |                       |
| N1                        | 3.752 (0.625–22.523) | .148                  |                       |                       |
| N2                        | 3.331 (0.745–14.903) | .115                  |                       |                       |
| N3a                       | 14.848 (4.033–54.670) | <.001                |                       |                       |
| N3b                       | 14.188 (3.506–57.410) | <.001                |                       |                       |
| rN                         | Reference           |                       |                       |                       |
| 1                          | 5.869 (2.250–15.306) | <.001                 |                       |                       |
| 2                          | 11.733 (4.189–32.862) | <.001                |                       |                       |
| TNM staging               |                     |                       |                       |                       |
| I                          | Reference           |                       |                       |                       |
| II                         | 0.000 (0.000–25300) | .943                  |                       |                       |
| III                        | 0.130 (0.044–0.387) | <.001                 |                       |                       |
| Scope of gastrectomy      | 0.297 (0.117–0.755) | .011                  |                       |                       |
| Radical degree            | 0.349 (0.161–0.755) | .008                  |                       |                       |
| Differentiation degree    | 0.658 (0.155–2.786) | .570                  |                       |                       |
| Lymphatic vascular invasion| 0.348 (0.161–0.753) | .007                  |                       |                       |
| Postoperative chemotherapy| 0.802 (0.359–1.787) | .589                  |                       |                       |

BOR = Borrmann, CI = confidence interval, EGC = early gastric carcinoma, HR = hazards ratio, rN = rate of N staging, TNM = tumor node metastasis, YGC = younger gastric cancer.
Univariate analysis of the clinical characteristics affecting OS in YGC group revealed the significant differences in tumor size, macroscopic types (except BOR2), T staging (except T2), N staging (N3a and N3b), rN, TNM staging (III), scope of gastrectomy, radical degree, and lymphatic vascular invasion. Multivariate analysis of OS in YGC group showed that gender, N staging, rN (2), radical degree were the independent prognostic factors of younger patients with GC. In comparison, multivariate analysis of OS in OGC group showed that tumor sites, macroscopic types, N staging (N3b), rN, radical degree, lymphatic vascular invasion and postoperative chemotherapy were the independent prognostic factors of older patients with GC. These results suggested there are much more independent prognostic factors of older patients with GC than that of younger patients.

Because we found differences in sex ratio between the age groups with GC, we compared these traits between the sexes in the group 40 years of age. However, no sex-based differences were found except for radical degree and lymphatic vascular invasion. Most of the results are in agreement with reports in the literature. In comparison, the significant differences in tumor sites were found between male and female patients in OGC group. However, no significant differences in other categories were shown between male and female patients in OGC group.

The imitation of this study is that this was a retrospective study at a single institution. Perspective and multi-center studies will be used in the future study.

5. Conclusions
To conclude, YGC patients differ from OGC patients in predominance of women, macroscopic types, T staging and differentiation degree. The prognosis of YGC patients was equivalent to that of OGC patients. Gender, N staging, rN (2), radical degree were independent risk factors for prognosis in YGC patients.

Author contributions
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Table 5
Clinicopathological features of YGC patients based on gender.

| Category                  | Male, n (%) | Female, n (%) | P      |
|---------------------------|-------------|---------------|--------|
| Family history of tumor   |             |               | .594   |
| Yes                       | 3 (12.5)    | 5 (17.9)      |        |
| No                        | 21 (87.5)   | 23 (82.1)     |        |
| Tumor sites               |             |               | .496   |
| Upper third               | 1 (4.2)     | 0 (0)         |        |
| Middle third              | 6 (25)      | 4 (13.3)      |        |
| Lower third               | 16 (66.7)   | 22 (75.8)     |        |
| Total stomach             | 1 (4.2)     | 2 (7.1)       |        |
| Complications             |             |               | .182   |
| Yes                       | 0 (0)       | 2 (7.1)       |        |
| No                        | 24 (100)    | 26 (92.9)     |        |
| Tumor sizes (cm)          |             |               | .772   |
| ≦5                        | 18 (75)     | 20 (71.4)     |        |
| >5                        | 6 (25)      | 8 (28.6)      |        |
| Macropscopic types        |             |               | .417   |
| EGC                       | 8 (33.3)    | 9 (32.1)      |        |
| BOR1                      | 0 (0)       | 1 (3.6)       |        |
| BOR2                      | 0 (0)       | 2 (7.1)       |        |
| BOR3                      | 15 (62.5)   | 13 (46.4)     |        |
| BOR4                      | 1 (4.2)     | 3 (10.7)      |        |
| T staging                 |             |               | .417   |
| T1                        | 8 (33.3)    | 9 (32.1)      |        |
| T2                        | 1 (4.2)     | 3 (10.7)      |        |
| T3                        | 10 (41.7)   | 6 (21.4)      |        |
| T4a                       | 3 (12.5)    | 4 (14.3)      |        |
| T4b                       | 2 (8.3)     | 6 (21.4)      |        |
| N staging                 |             |               | .381   |
| N0                        | 10 (41.7)   | 10 (35.7)     |        |
| N1                        | 3 (12.5)    | 1 (3.6)       |        |
| N2                        | 5 (20.8)    | 4 (13.3)      |        |
| N3a                       | 5 (20.8)    | 8 (28.6)      |        |
| N3b                       | 1 (4.2)     | 5 (17.9)      |        |
| rN                         |             |               | .126   |
| 1                         | 17 (70.8)   | 12 (42.9)     |        |
| 2                         | 4 (16.7)    | 10 (35.7)     |        |
| 3                         | 3 (12.5)    | 6 (21.4)      |        |
| T/NM staging              |             |               | .037   |
| I                         | 6 (25)      | 7 (25)        |        |
| II                        | 7 (29.2)    | 7 (25)        |        |
| III                       | 14 (56.8)   | 14 (50)       |        |
| Scope of gastrectomy      |             |               | .851   |
| TG                        | 3 (12.5)    | 4 (14.3)      |        |
| NTG                       | 21 (87.5)   | 24 (85.7)     |        |
| Radical degree            |             |               | .003   |
| Yes                       | 20 (83.3)   | 12 (42.9)     |        |
| No                        | 4 (16.7)    | 16 (57.1)     |        |
| Differentiation degree    |             |               | .110   |
| H+M                       | 4 (16.7)    | 1 (3.6)       |        |
| L+non                     | 20 (83.3)   | 27 (96.4)     |        |
| Lymphatic vascular invasion|           |               | .008   |
| Negative                  | 21 (87.5)   | 15 (53.6)     |        |
| Positive                  | 3 (12.5)    | 13 (46.4)     |        |
| Postoperative chemotherapy|             |               | .817   |
| Yes                       | 7 (29.2)    | 9 (32.1)      |        |
| No                        | 17 (70.8)   | 19 (67.9)     |        |
| 5-years OS (%)            | 49          | 50            | .753   |

BOR = Borrmann, EGC = early gastric carcinoma, NTG = non total gastrectomy, OS = overall survival, rN = rate of N staging, TNM = tumor node metastasis, TG = total gastrectomy, YGC = younger gastric cancer.

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