Are the elderly patient’s changes in the health-related quality of life one year after gastrectomy for stomach cancer different from those in young patients?

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INTRODUCTION

The number of elderly patients who underwent gastrectomy increased recently. This trend will be continued because life expectancy has been improved and the proportion of elderly patients is predicted to grow. In Korea, the proportion of elderly patients aged more than 70 years was continuously increased from 9.1% in 1995 to 25.3% in 2014 according to the Information Committee of the Korean Gastric Cancer Association [1]. The Surveillance, Epidemiology, and End Results (SEER) database in the United States also showed that elderly patients aged 80 years and more increased from 11.7% in period 1988–2003 to 13.1% in period 2004–2010 [2]. Although old age currently is not considered as an absolute...
contraindication to surgery for gastric cancer, postoperative morbidity and mortality in elderly patients were usually reported as higher than younger patients [3,4]. Gastrctomy can significantly deteriorate the health-related (HR) quality of life (QoL) [5-8]. As for surgical outcomes, there were many reports about morbidity, mortality, and survival rate. However, there were few studies about HRQoL in elderly patients.

The purposes of this study were to analyze the changes of the HRQoL in elderly patients who were 70 years old or older according to the periods (preoperative day, postoperative 1, 3, 6, 9, and 12 months) and to compare them with those of young patients.

METHODS

Patients

From May 2014 to February 2016, we prospectively enrolled patients undergoing gastrectomy. They were asked to complete the HRQoL questionnaires preoperatively and at 5 postoperative intervals up to 1 year (postoperative 1, 3, 6, 9, and 12 months). Patients who postoperatively completed at least 2 questionnaires were included and patients with (1) combined resection except for cholecystectomy and splenectomy, (2) previous or combined malignancies, or (3) neurologic or psychological conditions disable to answer the questionnaires were excluded. This study was approved by Institutional Review Board of SMG-SNU Borame Medical Center (No. 16-2014-127) and the written informed consent was obtained.

Surgery

All patients underwent surgery first according to Korean Practice Guideline for Gastric Cancer if the tumor is outside of the indication for endoscopic resection or and ≥T1b or cN+ and M0 gastric cancer [9] and upfront surgery is standard treatment for gastric cancer in Korea. Considering the location and clinical stage of tumor and the length of resectional margin, distal gastrectomy/pylorus-preserving gastrectomy or total gastrectomy was done. Reconstruction was performed with Billroth I or II gastrojejunostomy after distal gastrectomy, and Roux-en-Y esphagojejunostomy after total gastrectomy. D1+ lymphadenectomy and D2 lymphadenectomy were performed for early gastric cancer patients and advanced gastric cancer patients, respectively. Laparoscopic gastrectomy was performed if the tumor was not advanced.

After surgery, patients were placed on a diet program that included drinking water on the 3rd postoperative day, followed by a liquid and soft diet. Patients were planned to be discharged on the 7th day, postoperatively.

Health-related quality of life assessment

The HRQoL was assessed using the Korean version of European Organization for Research and Treatment of Cancer (EORTC) Quality of Life Questionnaires (QLQ). It consisted of the general module, the EORTC QLQ-C30, and the gastric cancer-specific module, the EORTC QLQ-STO22 [10-12]. The EORTC QLQ-C30 included 30 questions: a global health status/QoL scale, 5 functional scales (physical, role, emotional, cognitive, and social), and 9 symptoms scales/items (fatigue, nausea and vomiting, pain, dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial difficulties). The EORTC QLQ-STO22 is a supplement to the QLQ-C30 and is including 22 questions evaluating 9 symptom scales/items (dysphasia, chest and abdominal pain, reflux, eating restriction, dry mouth, taste, body image, anxiety, and hair loss).

The preoperative HRQoL assessment was performed when patients were hospitalized for surgery; alternatively, the postoperative HRQoL assessment was performed at the outpatient department. For global QoL and the functional scales, a higher score indicates better HRQoL, with 0 being perfect. For symptom scales, a lower score indicates better HRQoL with 0 being perfect or no symptoms reported.

Statistics

Demographic and clinical parameters of both age groups (70 years or older vs. 69 years or younger) were summarized using mean ± standard deviation for continuous variables and frequency (percentage) for categorical variables. The differences in the continuous variables were compared using 2-sample t-test and/or Wilcoxon rank-sum test and Pearson chi-square tests, and exact binomial tests were used to compare the distributions in categorical variables. Normal quantile-quantile plots were examined for checking normality of HRQoL assessment. For comparison between the age groups at each time point, 2-sample t-test were used. For comparison between adjacent time points, 2-sample t-tests were conducted. To account for within-individual correlations, mixed-effects models were fitted for each of 24 HRQoL outcomes adjusting for age, sex, extent of gastrectomy (partial or whole), minimal invasive gastrectomy (open or laparoscopic gastrectomy), TNM stage, postoperative chemotherapy, time, time2, and age × time2, respectively.

To address missing data due to dropouts, we also explored last-observation carried forward approach (LOCF) and the inverse probability weight (IPW) [13]. A 2-sided P-value of <0.05 was considered statistically significant. For statistical analysis, the R program package (R Foundation for Statistical Computing, Vienna, Austria: http://www.r-project.org) and IBM SPSS Statistics ver. 23 (IBM Corp., Armonk, NY, USA) was used.

RESULTS

Patients

All 252 patients were screened and 144 patients were eligible...
Table 1. Patients’ demographic, surgical, and tumor characteristics

| Characteristic                          | Elderly group (n = 57) | Young group (n = 74) | P-value |
|-----------------------------------------|------------------------|----------------------|---------|
| Age (yr)                                | 75.5 ± 4.4             | 56.2 ± 9.1           | <0.001  |
| Sex                                     |                        |                      |         |
| Male                                    | 41 (72.9)              | 51 (68.9)            | 0.847   |
| Female                                  | 16 (28.1)              | 23 (31.1)            |         |
| Body mass index (kg/m²)                 | 23.5 ± 3.5             | 23.5 ± 2.9           | 0.919   |
| Comorbidity (+)                         | 43 (75.4)              | 38 (54.4)            | 0.005   |
| Pulmonary disease                       | 7 (12.3)               | 1 (1.4)              | 0.010   |
| Laparoscopy                             | 49 (86.0)              | 54 (73.0)            | 0.072   |
| Operation extent                        |                        |                      |         |
| Distal                                  | 46 (80.7)              | 56 (75.7)            | 0.492   |
| Total                                   | 11 (19.3)              | 18 (24.3)            |         |
| Anastomosis, BI/BII/Roux-enY            | 11/35/11               | 27/26/18             | 0.013   |
| No. of retrieved LN                     | 39.4 ± 15.7            | 40.5 ± 14.3          | 0.692   |
| Operation time (min)                    | 172.0 ± 29.7           | 166.7 ± 38.5         | 0.623   |
| TNM stage                               |                        |                      |         |
| T1                                      | 37 (64.9)              | 48 (64.9)            | 0.526   |
| N0                                      | 38 (66.7)              | 50 (67.6)            | 0.913   |
| M0                                      | 54 (94.7)              | 73 (98.6)            | 0.317   |
| TNM stage according to AJCC 7th edition |                        |                      |         |
| I                                       | 40 (70.2)              | 47 (63.5)            | 0.365   |
| II                                      | 6 (10.5)               | 13 (17.6)            |         |
| III                                     | 8 (14.0)               | 13 (17.6)            |         |
| IV                                      | 3 (5.3)                | 1 (1.4)              |         |
| Hospital stay day                       | 10.2 ± 9.2             | 8.0 ± 1.9            | 0.050   |
| Morbidity in 30 day                     | 16 (28.1)              | 16 (21.6)            | 0.394   |
| Mortality in 30 day                     | 0 (0)                  | 0 (0)                |         |
| Reoperation                             | 0 (0)                  | 0 (0)                |         |
| Postoperative chemotherapy              | 10 (17.5)              | 24 (32.4)            | 0.054   |
| Recurrence within 1 yr                  | 5 (8.8)                | 4 (5.4)              | 0.502   |
| Death within 1 yr                       | 1 (1.8)                | 1 (1.4)              | 0.852   |

Values are presented as mean ± standard deviation or number (%).

BI, Billroth I; BII, Billroth II; LN, lymph node; AJCC, American Joint Committee on Cancer.
and finally 57 elderly patients (≥70 years old) and 74 younger patients were included (Fig. 1). Patients’ characteristics were summarized in Table 1. The elderly patients had similar demographic, surgical, and pathological characteristics with young patients while the elderly had more comorbidity \((P = 0.005)\), especially pulmonary disease \((P = 0.010)\). The elderly patients tend to have more laparoscopic surgery. Billroth II anastomosis after distal gastrectomy, longer hospital stay, and more frequent postoperative chemotherapy, which were not significantly different from the younger patients. There were also no significant differences in morbidity, mortality, and reoperation, respectively.

**Changes of HRQoL 1 year after gastrectomy**

Table 2 showed preoperative HRQoL scores of the age groups. Preoperatively, elderly patients had lower score of physical functioning and more symptoms of dyspnea and dysphagia.

Postoperative longitudinal changes of HRQoL were shown in Fig. 2. The elderly patients’ scores of global health status/QoL, physical functioning, role functioning, and social functioning were severely deteriorated one month after gastrectomy. The scores of global health status/QoL and emotional functioning were recovered to some degree of preoperative levels but those of physical functioning, role functioning, cognitive functioning, and social functioning were not fully recovered till 1 year after surgery. Pain, appetite loss, and financial difficulties were worsened 1 month after gastrectomy and improved till 1 year after surgery. Fatigue and diarrhea were continuously worsened after gastrectomy. Dysphagia, chest and abdominal pain, eating restriction, and dry mouth showed similar patterns which were worsened 1 month after gastrectomy and improved till 1 year after surgery. But they were not completely recovered.

**Predictive factors for HRQoL**

Noting that HRQoL could be confounded with demographical (age and sex) and clinical factors (extent of gastrectomy, laparoscopic gastrectomy, TNM stage, and postoperative chemotherapy), multivariable adjusted regression analysis using mixed-effects models were performed for each HRQoL, respectively (Table 3). Considering the age groups, on average over the 1-year follow-up, the elderly group appeared to show

| Questionnaire                                      | Elderly group (n = 57) | Young group (n = 74) | P-value |
|----------------------------------------------------|------------------------|----------------------|---------|
| QLQ-C30 global health and function                 |                        |                      |         |
| Global health status and quality of life           | 63.2 ± 25.4            | 61.3 ± 22.5          | 0.458   |
| Physical functioning                               | 85.0 ± 16.2            | 90.4 ± 15.6          | 0.006   |
| Role functioning                                   | 87.7 ± 23.5            | 90.8 ± 22.4          | 0.191   |
| Emotional functioning                              | 81.7 ± 23.0            | 77.0 ± 23.1          | 0.102   |
| Cognitive functioning                              | 90.4 ± 14.1            | 92.3 ± 15.2          | 0.249   |
| Social functioning                                 | 87.1 ± 23.8            | 81.5 ± 27.8          | 0.218   |
| QLQ-C30 symptom                                    |                        |                      |         |
| Fatigue                                            | 17.0 ± 18.9            | 18.8 ± 22.4          | 0.942   |
| Nausea and vomiting                                | 4.7 ± 11.3             | 7.2 ± 15.9           | 0.556   |
| Pain                                               | 6.4 ± 18.0             | 7.9 ± 15.9           | 0.177   |
| Dyspnea                                            | 20.5 ± 32.6            | 9.9 ± 23.9           | 0.030   |
| Insomnia                                           | 25.2 ± 36.9            | 18.5 ± 28.2          | 0.497   |
| Appetite loss                                      | 22.8 ± 35.7            | 14.0 ± 27.6          | 0.143   |
| Constipation                                       | 19.3 ± 32.1            | 11.0 ± 22.9          | 0.149   |
| Diarrhea                                           | 7.0 ± 23.4             | 10.4 ± 22.0          | 0.084   |
| Financial difficulties                             | 25.2 ± 33.5            | 27.5 ± 34.2          | 0.684   |
| QLQ-STO22 symptom                                  |                        |                      |         |
| Dysphagia                                          | 10.0 ± 12.2            | 5.6 ± 11.5           | 0.011   |
| Chest and abdominal pain                           | 7.5 ± 11.5             | 11.7 ± 17.1          | 0.221   |
| Reflux symptoms                                    | 10.9 ± 16.3            | 11.7 ± 18.3          | 0.905   |
| Eating restriction                                 | 8.0 ± 13.3             | 8.3 ± 15.2           | 0.723   |
| Having a dry mouth                                 | 26.9 ± 31.1            | 22.1 ± 30.4          | 0.291   |
| Taste                                              | 10.5 ± 28.3            | 6.3 ± 17.2           | 0.949   |
| Body image                                         | 3.5 ± 12.1             | 7.7 ± 19.5           | 0.199   |
| Anxiety                                            | 36.8 ± 26.4            | 44.0 ± 22.3          | 0.073   |
| Hair loss                                          | 7.0 ± 15.7             | 5.2 ± 17.4           | 0.135   |

Values are presented as mean ± standard deviation. Assessed using European Organization for Research and Treatment of Cancer Quality of Life Questionnaires (QLQ).
Fig. 2. Periodic changes in health-related quality of life (QoL) scores. *Significant difference between the elderly and young patients (P < 0.05).
lower scores in physical function compared to the younger group (mean difference [MD], –8.663; 95% confidence interval [CI], –13.702 to –3.623; P = 0.001) (Fig. 2) while there are no statistically significant differences in global health status/QoL (MD, –0.353; 95% CI, –5.886 to 5.181; P = 0.901). Considering the age group and time change together, there was a significant age group difference in the changes in physical function over the 1-year follow-up where the elderly group tends to decrease in their physical function after 9 months (P = 0.035) (Table 3). The score of global health status/QoL shows the similar pattern until the 1st month after surgery; however, there were opposite trends between the 2 groups while this difference did not reach statistical significance (P = 0.066) (Table 3, Fig. 2). Elderly patients had significant appetite loss and dry mouth (P = 0.013 and P = 0.017, respectively).

Meanwhile, total gastrectomy, laparoscopic gastrectomy, postoperative chemotherapy, TNM stage, and sex also significantly affect some scores of HRQoL after gastrectomy (Table 4).

DISCUSSION

Patients after gastrectomy were reported to encounter functional impairments and symptoms, but experience only a slightly impaired global HRQoL [5,8]. HRQoL deteriorations in physical, role, and cognitive functioning scales, and significant reductions lasted till 36-month after total gastrectomy [14]. Persistent QoL deterioration after distal subtotal gastrectomy is primarily due to financial difficulties, eating restrictions, and body image concerns [6].

However, there was no report that compares HRQoL of elderly and young patients after gastrectomy for gastric cancer. This study demonstrated the difference in HRQoL between elderly patients and young patients. Elderly patients’ score of global health status/QoL, physical functioning, role functioning, and social functioning were significantly deteriorated at postoperative 1 month. Among them, physical and role functioning were more impaired than those of young patients.

Furthermore, the scores of impaired physical functioning, role functioning, cognitive functioning, and social functioning were not restored till postoperative 1 year. This study also demonstrated that there was a significant age group difference in the longitudinal changes in physical function over the 1-year follow-up, but not in global health status/QoL.

Except for age groups, other factors related to HRQoL identified in this study were time trend, sex, total gastrectomy, laparoscopic gastrectomy, and postoperative chemotherapy. Total gastrectomy was known to have more negative effect on HRQoL than distal gastrectomy [5,7,8,14-17], which preserves more stomach and requires a less extensive lymphadenectomy. The lower HRQoL of women was consistent with other studies [5,18]. Laparoscopic distal gastrectomy resulted in significantly better HRQoL scores on global health status/QoL and most functionings [5,7,19] and many randomized controlled trials to support this are ongoing [20-22].

This study has several limitations. First, EORTC QLQ-C30 and QLQ-STO22 tools were not optimized for elderly patients and tended to overestimate the HRQoL of the elderly. For comparison with young patients, using well-established tool like EORTC QLQ was inevitable. Second, a large amount of missing data occurred during the follow-up. Most participants showed up for scheduled visit, but some refused to complete the HRQoL assessments because they felt the QoL questionnaire too burdensome. Twelve patients (8.3%) were excluded owing to incomplete follow-ups and a further 35.4% (51 of 144) were included but had incomplete data. An additional 1.4% of patients died during follow-up. We explored several approaches to account for missing data, including various joint likelihood-factorization techniques for longitudinal studies. For example, we found that result showed similar results when we analyzed our data using the LOCF and IPW approaches (Supplementary Fig. 1) [13]. However, we acknowledge that missing data approaches methods suffered from inherent limitations as we cannot test the performances of each approach in the absence of actual observations. Thus in this study, we excluded missing data points from the analysis and used the completely observed
| Endpoint | Age (elderly/young) | Time | Time² | Age × time² |
|----------|--------------------|------|-------|-------------|
|          | Est. (95% CI) | P-value | Est. (95% CI) | P-value | Est. (95% CI) | P-value | Est. (95% CI) | P-value |
| QLQ-C30 global health and function | | | | |
| Global health status and quality of life | -0.350 (–5.886 to 5.181) | 0.901 | 1.089 (–0.066 to 2.245) | 0.065 | -0.021 (–0.121 to 0.079) | 0.683 | -0.051 (–0.106 to 0.003) | 0.066 |
| Physical functioning | -8.663 (–13.702 to –3.623) | 0.001* | -0.897 (–1.807 to 0.012) | 0.053 | 0.086 (0.007 to 0.164) | 0.033 | -0.046 (–0.089 to –0.003) | 0.035 |
| Role functioning | -5.943 (–12.365 to –0.479) | 0.130 | -1.131 (–2.595 to 0.332) | 0.107 | 0.154 (0.028 to 0.281) | 0.017 | -0.054 (–0.123 to 0.015) | 0.123 |
| Emotional functioning | 2.668 (–2.874 to 8.21) | 0.015 | 2.462 (1.105 to 3.818) | 0.001* | -0.18 (–0.297 to –0.063) | 0.003* | -0.043 (–0.107 to 0.02) | 0.183 |
| Cognitive functioning | -1.815 (–5.651 to 2.02) | 0.649 | -0.185 (–0.983 to 0.613) | 0.051 | -0.015 (–0.052 to 0.023) | 0.442 |
| Social functioning | 2.641 (–3.813 to 9.096) | 0.001 | 0.950 (–0.35 to 2.251) | 0.004* | -0.078 (–0.198 to 0.041) | 0.017 | -0.005 (–0.089 to 0.034) | 0.381 |
| QLQ-C30 symptom | | | | |
| Fatigue | 3.632 (–2.893 to 10.156) | 0.001 | 1.263 (–0.112 to 2.642) | 0.073 | -0.078 (–0.198 to 0.041) | 0.197 | 0.015 (–0.05 to 0.08) | 0.654 |
| Nausea and vomiting | -1.906 (–5.416 to 1.604) | 0.001 | 0.652 (–0.261 to 1.565) | 0.162 | -0.067 (–0.146 to 0.012) | 0.097 | 0.027 (–0.016 to 0.07) | 0.210 |
| Pain | -3.426 (–8.461 to 1.609) | 0.085 | -0.098 (–1.175 to 0.979) | 0.858 | 0.001 (–0.092 to 0.094) | 0.898 | 0.025 (–0.026 to 0.076) | 0.331 |
| Dyspnea | 0.619 (–5.611 to 6.849) | 0.110 | -1.197 (–3.137 to –0.822) | 0.001* | 0.132 (0.032 to 0.232) | 0.010 | 0.068 (0.013 to 0.123) | 0.015 |
| Insomnia | 5.87 (–2.661 to 14.401) | 0.171 | -1.119 (–2.711 to 0.333) | 0.126 | 0.095 (–0.037 to 0.227) | 0.157 | -0.020 (–0.092 to 0.052) | 0.587 |
| Appetite loss | 8.329 (1.73 to 14.928) | 0.015 | -2.845 (–4.762 to –0.929) | 0.004* | 0.152 (–0.014 to 0.317) | 0.072 | -0.039 (–0.129 to 0.051) | 0.390 |
| Constipation | 6.587 (–0.62 to 13.794) | 0.125 | -1.427 (–2.949 to 0.095) | 0.066 | 0.103 (–0.028 to 0.234) | 0.125 | -0.015 (–0.087 to 0.057) | 0.686 |
| QLQ-STO22 symptom | | | | |
| Diarrhea | -4.102 (–9.671 to 1.467) | 0.149 | 1.731 (0.267 to 3.195) | 0.020 | -0.061 (–0.187 to 0.065) | 0.343 | -0.049 (–0.118 to 0.02) | 0.163 |
| Financial difficulties | -0.355 (–9.473 to 8.763) | 0.939 | -1.244 (–2.756 to 0.269) | 0.107 | 0.053 (0.077 to 0.184) | 0.425 | 0.005 (–0.067 to 0.076) | 0.399 |
| Dysphagia | 3.485 (–0.026 to 6.995) | 0.198 | -0.551 (–1.391 to 0.289) | 0.298 | -0.01 (–0.05 to 0.029) | 0.614 |
| Chest and abdominal pain | -3.13 (–7.189 to 0.929) | 0.131 | -0.526 (–1.407 to 0.355) | 0.338 | 0.017 (–0.024 to 0.059) | 0.418 |
| Reflux symptoms | -1.305 (–4.866 to 2.257) | 0.473 | -0.889 (–1.738 to –0.041) | 0.040 | 0.058 (–0.016 to 0.131) | 0.123 | 0.018 (–0.022 to 0.058) | 0.372 |
| Eating restriction | -0.794 (–5.008 to 3.42) | 0.624 | -0.243 (–0.727 to 1.213) | 0.624 | -0.042 (–0.126 to 0.042) | 0.328 | 0 (–0.046 to 0.045) | 0.991 |
| Having a dry mouth | 10.301 (1.86 to 18.742) | 0.001 | -1.315 (–2.846 to 0.216) | 0.092 | 0.077 (0.055 to 0.21) | 0.252 | -0.007 (–0.08 to 0.065) | 0.841 |
| Taste | 2.866 (–4.087 to 9.819) | 0.419 | 0.654 (–1.029 to 2.338) | 0.446 | -0.095 (–0.24 to 0.05) | 0.199 | 0.002 (–0.077 to 0.082) | 0.955 |
| Body image | -2.543 (–9.878 to 4.791) | 0.497 | 3.754 (2.134 to 5.375) | <0.001* | -0.299 (–0.438 to –0.159) | <0.001* | 0.070 (–0.006 to 0.147) | 0.072 |
| Anxiety | -1.992 (–8.542 to 4.358) | 0.551 | -2.275 (–3.486 to –1.063) | <0.001* | 0.122 (0.017 to 0.227) | 0.022 | 0.025 (–0.032 to 0.082) | 0.391 |
| Hair loss | -1.779 (–7.122 to 3.963) | 0.001 | 0.152 (–0.014 to 0.317) | 0.072 | -0.039 (–0.129 to 0.051) | 0.390 |

Assessed using European Organization for Research and Treatment of Cancer Quality of Life Questionnaires (QLQ).

EST., estimate; CI, confidence interval.

*Significant difference (P < 0.05).
Table 4. Parameter estimates for 24 health-related quality of life outcomes except age and time

| Endpoint                                      | Male sex | Postop chemotherapy | Distant/total | Open/laparoscopic | TNM stage | P-value | Female sex | Postop chemotherapy | Distant/total | Open/laparoscopic | TNM stage | P-value | Female sex | Postop chemotherapy | Distant/total | Open/laparoscopic | TNM stage | P-value |
|-----------------------------------------------|---------|---------------------|--------------|-------------------|-----------|---------|------------|---------------------|--------------|-------------------|-----------|---------|------------|---------------------|--------------|-------------------|-----------|---------|
| QLQ-C30 global health and function           |         |                     |              |                   |           |         |            |                     |              |                   |           |         |            |                     |              |                   |           |         |
| Global health status and quality of life      | 3.292   | (–2.187 to 8.771)   | 0.239        | –0.001            | 0.113     | 0.414   | –0.799     | 0.401               | 0.113        | 0.414             | –0.799     | 0.401   |            |                     |              |                   |           |         |
| Physical functioning                          | 2.831   | (–2.318 to 7.971)   | 0.177        | –0.040            | –0.014    | 0.988   | –0.866     | 0.401               | –0.075       | 0.968             | –0.982     | 0.360   |            |                     |              |                   |           |         |
| Role functioning                              | 2.363   | (–1.956 to 6.672)   | 0.133        | 0.020             | 0.022     | 0.988   | –0.270     | 0.789               | 0.022        | 0.988             | –0.270     | 0.789   |            |                     |              |                   |           |         |
| Emotional functioning                         | 9.427   | (4.139 to 14.715)   | 0.000*       | 0.000*            | 0.000*    | 0.000   | –1.262     | 0.213               | 0.000*       | 0.000*            | –1.262     | 0.213   |            |                     |              |                   |           |         |
| Cognitive functioning                         | 3.416   | (–0.385 to 7.215)   | 0.078        | –0.036            | –0.036    | 0.999   | 0.250      | 0.812               | –0.036       | 0.999             | 0.250      | 0.812   |            |                     |              |                   |           |         |
| Social functioning                            | –0.111  | (–6.544 to 6.322)   | 0.973        | 0.000             | 0.000     | 0.000   | –1.217     | 0.223               | 0.000        | 0.000             | –1.217     | 0.223   |            |                     |              |                   |           |         |
| QLQ-STO22 symptom                             | –1.645  | (–4.090 to 0.049)   | 0.078        | –0.036            | –0.036    | 0.999   | 0.250      | 0.812               | –0.036       | 0.999             | 0.250      | 0.812   |            |                     |              |                   |           |         |
| Dysphagia                                     | –2.612  | (–5.223 to 0.000)   | 0.078        | –0.036            | –0.036    | 0.999   | 0.250      | 0.812               | –0.036       | 0.999             | 0.250      | 0.812   |            |                     |              |                   |           |         |
| Chest and abdominal pain                      | –2.055  | (–5.405 to 1.297)   | 0.078        | –0.036            | –0.036    | 0.999   | 0.250      | 0.812               | –0.036       | 0.999             | 0.250      | 0.812   |            |                     |              |                   |           |         |

Assessed using European Organization for Research and Treatment of Cancer Questionnaires (QLQ).

Significant difference (P < 0.05).

*Significant difference (P < 0.05).
data for transparency. Third, EORTC assessments consist of a lot of questions so that the rate of questionnaire completion is relatively low. To boost the completion rate and the patient retention rate, reward programs can be considered for a future study. Lastly, this study lacked long-term results and the strategy to reduce the missing data or the cross-sectional study design may help this limitation. But when we reviewed the previous studies which showed that time trend is mainly associated with HRQoL in the early recovery period whereas HRQoL remains relatively stable after the 1st year following surgery [5,15,16,23], similar long-term results were expected.

Future research includes (1) nonlinear trend over the course of follow-up using the nonlinear mixed effects model; (2) the time-varying nutrition in the regression model to better understand the impact of the nutrition on the HRQoL of the patient.

In summary, elderly patients had lower score of physical functioning before surgery. Global health status/QoL, physical functioning, role functioning, and social functioning were deteriorated 1 month after gastrectomy and improved 3 months after gastrectomy. But those were not fully recovered. Age group significantly affected the scores of physical functioning and the difference last till 1-year after surgery.

In conclusion, elderly patients’ QoL, especially physical functioning, was not completely recovered one year after gastrectomy unlike those of younger patients. Hence surgeons need to pay more attention to the elderly patients’ QoL after gastrectomy.

SUPPLEMENTARY MATERIALS

Supplementary Fig. 1 can be found via https://doi.org/10.4174/astr.2021.100.1.8.

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Conflict of Interest
No potential conflict of interest relevant to this article was reported.

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