ORIGINAL CONTRIBUTION

What is the Distribution of “Curable-duration” of Gastric Cancer?

Shogo Kikuchi¹, Yutaka Inaba¹, and Osamu Wada²

We defined curable-duration of gastric cancer as the duration during which a gastric cancer is detectable by screening by contrasted indirect roentgenography and is also curable by therapy, and estimated its distribution using data from a group consisting of 66,386 employees. The total of observed person-years was 179,204. The distribution of curable-duration was shown to be M-shaped; the two peaks were at under 1 year and over 4 years.

Consequently it was concluded that one should attend screening by contrasted indirect roentgenography at an interval of 2 or 3 years, and that this will make the screening programs more efficient. J Epidemiol, 1992; 2 : 69-73.

curable-duration, mass-screening for gastric cancer, contrasted indirect roentgenography, interval of screenings

It is an important problem how often one should attend the screening for gastric cancer. We attempted to address this problem by observing the distribution of curable-duration of gastric cancer. Curable-duration of gastric cancer is defined as the duration during which a gastric cancer is detectable by screening and is also curable by therapy¹). If one attends screening for gastric cancer at an interval less than curable duration, there is no probability that one will die of gastric cancer. The length of curable-duration naturally depends on the method of screening; the curable-duration in the screening by endoscopy is usually longer than that in the screening by contrasted indirect roentgenography. The purpose of this study was to estimate the distribution of curable-duration in the screening by contrasted indirect roentgenography.

SUBJECTS AND METHODS

The subjects of the study were 66,386 employees insured by one of three health insurance societies located in the Tokyo metropolitan area. These three health insurance societies consist of employees belonging to about a hundred small or middle scale companies dealing with steel, textile or paper products.

The incidence of gastric cancer was observed for all subjects, using data from “receipts” (detailed bills for payment of medical fees), which specify the diagnosis and the details of the medical service. The observation was carried out by checking up all receipts regarding the subjects for 2 to 4 year periods (1982-1985 on a health insurance society, 1983-1985 on another one and 1984-1985 on the other one). The receipts provide information on diagnosis of the employees, whether they underwent operation or not, and whether they survived or not. All cases that underwent gastrectomy and received medical treatment thereafter with the diagnosis of gastric cancer were presumed as incidence cases. When a case did not undergo gastrectomy in spite of the diagnosis of gastric cancer, the case was presumed as an incidence case, if the case had not received medical treatment as a patient of gastric cancer in the past 3 years.

All incidence cases were followed up for 5 years, using the “receipts” or resident cards held by municipalities, to ascertain whether they survived or not. Deaths among them were presumed as being due to gastric cancer. The term “mortality rate of gastric cancer” means the incidence rate of gastric cancer that causes death within five years after diagnosis.

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The analysis was done by person-year method. With respect to all person-years, the period (called "incubating period" below conveniently) between the time when incidence was observed and the preceding screening where they were diagnosed as no-abnormality, was examined using the records kept by the health insurance societies which administer the screening program. Since old records were missing, the records during the past 4 years of incidence observation were available with respect to all person-years. If they were diagnosed by screening as having gastritis, gastric ulcer, duodenal ulcer or gastric polyp, the previous screening where they were diagnosed as no-abnormality was considered to be the beginning of "incubating period", because the lesion might be diagnosed as gastric cancer afterwards. "Incubating period" was classified into three categories: 1 year (1-year-group), 2 to 3 years (2,3-year-group) and not less than 4 years (4+-year-group). If the screening which determined the beginning of "incubating period" was done by any method other than contrasted indirect roentgenography, the person-year was removed from the analysis. Whether they were screened during the year of the incidence observation (screened group) or not (not-screened group) was noted and analyzed. In the classification, incidence cases were classified into the not-screened group if they were not diagnosed by screening, even if they were screened during the year of the incidence observation.

Total person-years were divided into three small groups by "incubating period". Each small group was divided into six strata by sex and age (-39, 40-59, 60-). Incidence and mortality risk ratios and their 95% confidence intervals for the 1-year-group and the 2, 3-year-group compared with the 4+-year-group, were calculated with the stratified data. The calculation was done by Miettinen's method\(^3\), and statistically significant level was established at \(p=0.05\).

**RESULTS**

Age and sex distributions of the total person-years are shown in Table 1, and observed incidence and death in Table 2.

Risk ratios of the 1-year-group and the 2, 3-year-group compared with the 4+-year-group are shown in

<table>
<thead>
<tr>
<th>Table 1. Sex and age distribution of person-year.</th>
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<tr>
<td><strong>Age</strong></td>
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</tr>
<tr>
<td>0-39</td>
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<tr>
<td>40-59</td>
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<td>60-</td>
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<tr>
<td><strong>Total</strong></td>
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% is calculated for 179204

<table>
<thead>
<tr>
<th>Table 2. Observed person-years, incidence and deaths from gastric cancer regarding screened group and not-screened group.</th>
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<tbody>
<tr>
<td><strong>Large group</strong></td>
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<tr>
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<tr>
<td>Screened</td>
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<td>Not-screened</td>
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Screened group: those who attended the screening in the year of incidence observation
Not-screened group: the rest
Death: incidence of fatal gastric cancer
1-year: the length between the time of incidence observation and the preceding screening for gastric cancer where he/she was diagnosed as no-abnormality (incubating period) was 1 year
2, 3-year: incubating period was 2 to 3 years
4+-year: incubating period was not less than 4 years

<table>
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<th>Table 3. Risk ratios compared with 4+-year-group.</th>
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<tr>
<td><strong>1-year-group (95% C.I.)</strong></td>
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<tr>
<td>Incidence</td>
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<tr>
<td>Mortality</td>
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Each group contains both screened employees and not-screened employees in the year of incidence observation
Mortality means incidence of fatal gastric cancer
C.I.: Confidence interval
Table 3. The mortality risk ratio of the 2, 3-year-group was 0.00 and its 95% confidence interval was 0.00-0.71, while that of 1-year-group was 0.86 and its 95% C.I. was 0.35-1.62.

Among the screened group, incidence and mortality rates per 100,000 person-years were respectively 47.3 and 6.0 in the 1-year-group, 62.6 and 0.0 in the 2, 3-year-group, and 102.5 and 28.3 in the 4+-year-group, which increased in proportion to “incubating period” except that mortality rate in the 2, 3-year-group was 0.0. No statistically significant differences of incidence or mortality rates were observed among the small groups. These results are diagrammatically represented in Figure 1.

Among the not-screened group, incidence and mortality rates were 82.4 and 45.0 in the 1-year-group, 28.8 and 0.0 in the 2, 3-year-group, 48.0 and 28.6 in the 4-year group. Statistically significant difference of both incidence rates (chi-square= 4.48) and mortality rates (chi-square=7.56) were observed between the 1-year-group and the 2, 3-year-group. These results are also diagrammatically represented in Figure 1.

**DISCUSSION**

Among the screened group, incubating period is equal to the interval between two screenings. The number of gastric cancers which grow to be detectable by screening is expected to be constant per time, and some gastric cancers show symptoms which are clinically diagnosed before the next screening and drop out of the screened group. Therefore the incidence rates among screened group are expected to become large in proportion to incubating period while incubating period is short, and reach a plateau at some point where incubating period is as large as the longest asymptomatic period of gastric cancers. The results in this study were consistent with the inference.

The results among the not-screened group reflect the distribution of asymptomatic-duration (=sojourn time); the duration between the time when a gastric cancer becomes detectable by screening and the appearance of symptom. Since both incidence rate and mortality rate were the lowest in the 2, 3-year-group, the distribution of asymptomatic-duration is posited as being M-shaped. This result was different from breast cancer, where the distribution of asymptomatic-duration is thought to be exponential.

Though curable-duration is different from asymptomatic-duration, the distribution of curable-duration is expected to be similar with the distribution of asymptomatic-duration. With respect to surviving patients of gastric cancer diagnosed by subjective symptom, asymptomatic-duration must be shorter than curable-duration, and with respect to patients died of gastric cancer who were diagnosed by subjective symptom, asymptomatic-duration must be longer than curable-duration (see Fig. 2). Therefore curable-duration of the patients who died in the 1-year-group must be shorter than 1 year and curable-duration of surviving patients in the 2, 3-year-group and the 4+-year-group must be longer than 2 years. Although curable-durations of surviving patients in the 1-year-group and the patients who died in the 4+-year-group could be 2 to 3 years, it was supposed that there were few gastric cancers in which the curable-durations were 2 to 3 years, because if this were not so incidence rate and mortality rate in 2, 3-year-group would have been
higher. The estimation that there were few gastric cancers in which the curable-durations were 2 to 3 years was consistent with the fact that mortality rates were low in the 2, 3-year-group among the screened group, whose members attended screening at an interval of 2 to 3 years.

There was a considerable number of patients whose curable-durations were shorter than 1 year. Many of the patients who died in the 1-year-group were classified as among the not-screened group even if they had attended screening every year because their cancers were diagnosed by symptom during the interval before they attended the next year’s screening. Since gastric cancers of these patients were expected to have been incurable when they grew to be found by screening, their curable-durations could not have been more than 0. Thus curable-durations were also thought to be distributed in an M-shape fashion: the two peaks were at about 0 years and over 4 years. Consequently increase of the mortality of gastric cancer is expected to be little, even if the recommended interval of attending screening for gastric cancer is altered from 1 year to 2 or 3 years.

An endoscopic study has suggested that gastric cancers are classified into two types by their way of growth: ones that make gastric mucosa uneven in early stage of growth and ones that grow without making unevenness until late stage. The former is thought to correspond to gastric cancers in which the curable-durations were over 4 years, and the latter to ones in which the curable-durations were under 1 year.

When the screened group and the not-screened group were combined for analysis, the mortality risk ratio of the 2, 3-year-group was 0.00 and that of the 1-year-group was 0.86. This also suggested that the recommended interval of attending screening for gastric cancer should be altered from 1 year to 2 or 3 years. This methodology of cohort study was the same as that adopted in determining the optimal interval of screenings for cervical cancer except that the length of observation was only 4 years in this study.

Several reports have argued as to how often one should attend screening for gastric cancer by contrasted indirect roentgenography. Although some concluded the interval should be 1 year, many concluded the interval should be 2 years. Two of these reports have estimated the relative risk of advanced gastric cancer with respect to the “incubating period” by the methodology of case-control study. The results of both reports were similar in that the relative risk increased in proportion to the “incubating period”; in other words, the risk was the lowest when “incubating period” was one year. The results were different from this study. This is thought to be because the cases of the two reports included only advanced gastric cancers diagnosed in a mass-screening program. Since as mentioned above, a considerable number of patients attended screening every year and were diagnosed by symptom during the interval before they attended the next year’s screening, the influence of length bias is not denied when clinically diagnosed patients are not included in the analysis.

Though the length of observation of this study is only 4 years and longer observation is necessary, it is suggested that one should attend screening for gastric cancer by contrasted indirect roentgenography at an interval of 2 or 3 years, which will make screening programs more efficient, because the cost of screening programs will decreases without increase of mortality rate.
ACKNOWLEDGEMENT

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REFERENCES


