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Carcinoma of the Alimentary Canal—A Statistical Study Based on Autopsy Data from 1928 to 1972

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Summary. An analysis of autopsy data shows that during the period 1928–1972 the relative frequency of carcinoma of the stomach has remained practically unchanged. A similar trend is apparant from the mortality statistics for Vienna from 1955 to 1972. Whereas for the lower and middle age groups there is a real decrease during the period 1928–1952, an opposite trend is visible for the highest age group. The stomach and the lower parts of the large intestine are the most frequent sites of carcinoma of the alimentary canal. The frequency distribution is explained on the basis of the "contact hypothesis".

Key words: Time variation – Alimentary tract carcinoma – Age factors – Site-frequency relationship – Contact hypothesis.

In previous publications (Om, 1974, 1975) the author showed that in the Viennese population there has been a continuous increase in the relative frequency of occurrence of carcinoma of the large intestine and pancreas during the last 4 or 5 decades. An inverse trend in the general populations has been reported for malignancy of stomach by various authors (Crumb et al., 1970; Cutler, 1969; Jordan, 1968; Krain, 1972; Stephenson, 1972). Whether this decrease is present for all age groups has not been analysed. This investigation was undertaken in order to determine whether a similar trend is visible in the present autopsy population or not.

Material and Methods

This study is based on autopsy data from the pathology department of the Wilhelminen Hospital in Vienna. The cases are derived from the urban population during the period 1928–1972. Out of about 60,000 autopsy records, all cases were selected in which the malignancy of upper alimentary tract was verified macroscopically and/or histologically. In these cases the part of the alimentary canal affected (esophagus, stomach, duodenum, ileum) as well as age and sex were recorded.

Carcinoma of the post-gastrectomized stomachs were not included in the present study because it could not be ascertained from the autopsy records whether the gastrectomy was performed because of the presence of an ulcer or malignancy.

During the period under study 1278 carcinomas of the stomach (703 males and 575 females) were observed. There were 8 cases of carcinoma of the duodenum (4 males and 4 females), 64 cases of carcinoma of the esophagus (46 males and 18 females) and only 3 cases of carcinoma of the ileum (all males) (Table 4). In addition 7 cases of sarcoma of the stomach (3 males and 4 females), 3 cases of sarcoma of the ileum (males), 5 carcinoids of the ileum (2 males and 3 females) and 1 malignant carcinoid of the appendix were observed. Since only carcinomas will be analyzed in the present paper, these cases are only mentioned for the sake of completeness.

In one male (80 years) two histologically distinct carcinomas were present in the stomach. (1) a cylinder cell carcinoma of the solid type and (2) a cylinder cell carcinoma of the glandular type. In one female aged 39, carcinoma of the stomach and duodenum were present simultaneously.

The data on mortality statistics due to malignancy of the stomach from 1955 to 1972 for the city of Vienna is presented in Table 1 along with the present data. Strict comparison is, however, not possible because of the fact, that whereas the present data include all cases with carcinoma of the stomach detected at the time of autopsy, irrespective of the primary cause of death, official statistics are based on cases with stomach cancer as the primary cause of death; all other cases with stomach cancer as a secondary finding are neglected. The conclusions from such data are misleading as the true frequency of occurrence of the malignancy cannot be calculated. (The method of collecting data for the official statistics is very deficient. A punch card system preserving all data obtained from autopsy findings is urgently needed.)

Analysis of the Data

For establishing the trend of variation of frequency of carcinoma of the stomach (the number of carcinomas of the esophagus and of ulcerous carcinoma of the stomach are too small for any fruitful analysis) since 1928, the data for both sexes were pooled for every subsequent period of 5 years and the rate of carcinomas per 1000 autopsies calculated (Table 1). As on first inspection no definite trend is visible; the χ^2 test was employed to check the homogeneity of the given distribution.

In order to determine whether there has been any change in the relative frequency of cancer of the stomach for different age groups with passage of time, the period under study was subdivided into periods A (1928–1952) and B (1953–1972). The total number of cases of the two sexes were divided into three age groups; (a) under 55, (b) 55–74 and (c) 75 and over; the corresponding percentages were calculated. From the census reports for 1923, 1934, and 1951 (in the period 1928–1952) and 1951, 1961 and 1971 (in the period 1953–1972) for the city of Vienna, the relative percentages for males and females were computed for the mentioned age groups. On the basis of these averages, the

Table 1. Trend of variation in frequency of carcinoma of stomach 1928–1972 (both sexes)

Years	Number of autopsies	Number of cases			Frequency of cancer of stomach per 1000 autopsies	Mortality statistical[b] average per year
		Carcinoma of stomach	Carcinoma of esophagus	Ulcerous cancer of stomach		
1928–1932	5,056	89	8	–	17.6	–
1933–1937	4,770	105	–	–	22.0	–
1938–1942	5,178	118	3	2	22.8	–
1943–1947[a]	5,404	89	8	3	16.5	–
1948–1952	5,838	134	10	11	23.0	–
1953–1957	6,000	161	8	7	26.8	955.3
1958–1962	5,592	180	6	10	32.2	990.8
1963–1967	8,347	168	8	15	20.1	887
1968–1972	11,408	226	13	16	19.8	824

[a] The year 1945 has been excluded
[b] Mortality statistics from Vienna from 1955 to 1972

Table 2. Carcinoma of stomach: Age-frequency relationship from autopsy data in males

		Age group (a)					Age group (b)				Age group (c)			Total
		under 35	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 74	75 79	80 84	85 and over	
Period 1928–1952 Total	A	4	9	8	15	30	42	63	57	41	37	5	4	315
		66 = 20.95%					203 = 64.4%				46 = 14.6%			
Rate per 100,000 of population		3.25					50.7				121.5			
Basic population distribution		82.22%					16.21%				1.57%			100%
Period 1953–1972 Total	B	1	1	3	9	22	32	63	67	78	54	43	15	388
		36 = 9.3%					240 = 62.0%				112 = 28.7%			
Rate per 100,000 of population		2.26					46.8				142.3			
Basic population distribution		73.2%					23.2%				3.6%			100%

relative frequencies per 100,000 population (from which the cases are derived) in the corresponding age groups were also calculated (Tables 2 and 3), thus enabling more exact comparisons.

The relative frequencies of carcinoma of different parts of the alimentary canal are given in Table 4. The data for the large intestine, included here, is taken from our earlier paper (Om, 1974).

It may be remarked that in our hospital the autopsy policy has remained unchanged and as a rule all hospital deaths are autopsied. In rare cases, in which the relatives of the deceased are emphatically against postmortem examination or in cases in which the diagnosis has been

Table 3. Carcinoma of stomach: Age-frequency relationship from autopsy data in females

		Age group (a)					Age group (b)				Age group (c)			Total
		under 35	35 39	40 44	45 49	50 54	55 59	60 64	65 69	70 74	75 79	80 84	85 and over	
Period 1928–1952	A	6	7	4	11	18	24	41	45	39	26	7	5	233
Total		46 = 19.7%					149 = 64.0%				38 = 16.3%			
Rate per 100,000 of population		1.94					25.8				50.4			
Basic population distribution		78.45%					19.07%				2.48%			100%
Period 1953–1972	B	2	–	–	5	14	15	24	37	76	77	67	25	342
Total		21 = 6.1%					152 = 44.4%				169 = 49.5%			
Rate per 100,000 of population		1.14					18.96				93.12			
Basic population distribution		65.0%					28.5%				6.5%			100%

Table 4. Carcinoma of alimentary canal: Site-frequency distribution for males and females

Site	Males (%)	Females (%)
Esophagus	46 (3.31)	18 (1.44)
Stomach	703 (50.54)	575 (45.93)
Duodenum	4 (0.29)	4 (0.32)
Ileum	3 (0.22)	–
Colon	208 (14.95)	252 (20.1)
Sigmoid	192 (13.8)	200 (16.0)
Rectum	235 (16.9)	200 (16.0)
Anus	–	3 (0.2)
Total	1391 (100)	1252 (100)

definitly established (at the time of surgical intervention), autopsy is not performed. Further, the absolute number of autopsies performed increases with time as the number of admissions increases. However, since we calculate the rate per 1000 autopsies, this factor is automatically compensated.

Results

Frequency of Carcinoma of Stomach-Time Relationship

The χ^2 analysis of the data shows that during the last 4 or 5 decades the relative frequency of carcinoma of the stomach in the autopsy collective has remained practically unchanged ($\chi^2 = 8.33$, df $= 8$, $50 > P > 10$).

The analysis of official data from 1955 to 1972 for Vienna shows a trend very similar to that apparant in the autopsy collective. From the yearly observed number of cases a mean value of $M \pm \sigma = 910 \pm 71.5$, where σ is the standard deviation, is obtained.

Carcinoma of Stomach-Age Relationship

The data are presented in Tables 2 and 3 for males and females respectively. Out of a total of 1278 carcinomas observed, the youngest was 20 years old and the oldest 94 years old. During the period 1928–1952 about 20% of the cases (both sexes) belonged to age group (a) whereas only about 8% of the cases were in the corresponding age group during 1953–1972. For age group (c) the corresponding figures are 15.34% and 38.49% respectively. The relative percentage of cases belonging to different age groups during the periods A and B are also given (Tables 2 and 3).

Site-Frequency Relationship

Of all the carcinomas occurring along the alimentary canal (Table 4) about 40–50% occur in the stomach and another 40–50% in the large intestine. Malignancy is very rare in the duodenum and ileum. About 2–3% of the total number of cancers of the alimentary canal occur in the oesophagus. The distributions for the two sexes are very similar.

Discussion

It is evident from Table 1 that, contrary to the trend (continuous increase) observed for carcinoma of the large intestine and pancreas (Om, 1974, 1975), the relative frequency of carcinoma of the stomach in the present autopsy collective has remained practically constant over the last 4 or 5 decades. Various authors (Boles, 1958; Crumb et al., 1970; Cutler, 1969; Foote et al., 1966; Jordan, 1968; Knowelden, 1969; Krain, 1972; Stephenson, 1972) have reported that carcinoma of the stomach shows a continuously decreasing incidence. In our case no such trend is apparant, though perhaps one would be tempted to draw such a conclusion if one considered the data from 1958–1972 only. A very similar trend is visible from the official mortality data (insofar as a comparison is justified) from 1955 to 1972, which incidentally shows the utility of analyzing autopsy collectives.

From frequencies calculated on the basis of 100,000 ("average basic population") for different age groups, we find that, whereas for both sexes for age groups (a) and (b) there has been a real decrease from 1928 to 1952 to 1953 to 1972, the higher age group (c) shows an opposite trend. For this age group there has been a definite increase in the relative frequency of occurrence. Thus, a decrease for the lower age groups and a simultaneous increase for the higher age group balance each other. This type of differential age effect on the frequency of occurrence of carcinoma of the stomach has not been pointed out by any of the authors. Whether this has to do with changing dietary habits remains to be established. It has often been pointed out (Denk et al., 1967; Graham et al., 1972; Heyden, 1969; Knowelden, 1969; Paymaster et al., 1968) that the composition of food does effect the rate of incidence.

Site-Frequency Relationship

From Table 4 it mav be seen that for both sexes the frequency is the highest for the stomach and the large intestine. Similar results have been reported by Moldow and Connally (1968) for the Connecticut (USA) population. Paymaster et al. (1968), however, report that for the population in western India, carcinoma of the esophagus is the most common of alimentary tract carcinomas and that carcinoma of the stomach is not so frequent as in Western countries. Carcinoma of the duodenum and ileum is relatively very rare (Boles, 1958; Cortese and Cornell, 1972; Jefferson, 1916; Moldow and Connally, 1968; Pagtalunau et al., 1964; Rochlin and Langmire, 1961).

This type of frequency distribution of carcinoma in different parts of the alimentary canal may be explained by assuming that (1) the carcinogens are external to the body, i.e. they are introduced with the food consumed or are formed in the digest—a fact often mentioned—and (2) that the malignancy-producing effect depends upon the time of contact with the epithelium of the parts under consideration. It has been pointed out by the author in previous publications (Om, 1974; in press) that on general biological grounds such a distribution cannot be expected, and the well-known "contact hypothesis" has been suggested as an explanation.

As already stated, carcinoma of the ileum is very rare, in spite of its epithelium having a comparatively large surface area and active cell turnover (Cairns, 1975). This is because the dividing stem cells lie deeply (well protected) in the crypts and, therefore, seldom come in contact with food cancerogens. In addition, there is no stasis of the food in the ileum and active cancerogen-detoxifying mechanisms (Waltenberg, 1966) may be operating as well. All these factors together would explain the rarity of occurrence of carcinoma of ileum.

Further, the distention of the stomach produced by heavy meals brings the epithelium of the stomach into closer contact with food cancerogens. In the large intestine, particularly in the sigmoid and rectum, the stagnancy and accumulation of fecal matter has a similar effect.

It seems, therefore, that a great proportion of alimentary tract carcinomas arise due to faulty habits of overeating and neglect of regular evacuation of bowels and thus could be avoided. Which particular foods contribute to carcinogens remains to be discovered.

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