

LEUKEMIA IN SINGAPORE

By the Leukemia Study Group, Singapore*

The aetiology of human leukemia is still largely unknown and therefore variations in the incidence of leukemia in different population groups are of interest because of their potential aetiological significance.

Epidemiological studies have indicated that the incidence and mortality rates for leukemia have increased significantly throughout the world during the past few decades, W.H.O., 1955, 1960, 1962. How much of this increase is due to changes in the age distribution of the population, to improvements in the medical services or to better diagnostic facilities and the more ready recognition of atypical forms of the condition is doubtful, although Hayhoe, 1960, states that these factors cannot account for more than a small fraction of the increase. Dameshek and Gunz, 1964, however, are of the opinion that if there has been any increase in the incidence of leukemia it is a comparatively modest one.

In Singapore, Wells and Lau, 1960, reported an increase in the incidence of leukemia from 1.0 per hundred thousand population in 1949 to approximately 3.0 per hundred thousand in 1958. They accounted for this rise by the expansion of the medical services, improved laboratory and diagnostic facilities and the increasing acceptance of Western medicine by the local population.

The purpose of this paper is to present information which has been obtained in an attempt to answer a number of questions regarding leukemia in Singapore. Firstly, how widespread is leukemia today, and whether there is any evidence to suggest a rise in the incidence over the

past few years. Secondly, whether there are any age, sex, morphologic or ethnic differences in the pattern of leukemia in Singapore and to compare these with reports from other centres.

METHODS AND MATERIALS

We have examined all the available case records of patients diagnosed as suffering from leukemia admitted into all the Government Hospitals in Singapore for the 5 year period between 1961 to 1965. After a re-examination of the clinical and diagnostic criteria and elimination of duplicate and doubtful cases we have documented a total of 280 cases of leukemia of all varieties. The analysis of these patients is presented herewith. Population statistics and mortality figures were obtained from the Department of Statistics, Singapore.

GENERAL INCIDENCE OF LEUKEMIA

The total number of new cases of leukemia discovered during the years 1961 to 1965 is shown in Table I. The incidence ranged from 2.8 per hundred thousand to 3.5 per hundred thousand population at risk. There is no evidence to suggest a significant increase in the incidence over the past 5 years.

MORTALITY FROM LEUKEMIA

The total number of deaths certified as being due to leukemia for the corresponding period is also shown in Table I. Mortality rates ranged from 2.2 per hundred thousand in 1961 to 3.4 per hundred thousand in 1965. We do not believe that this represents a true increase in the

* S. B. Kwa, M.B., M.R.C.P.E., M.R.C.P.G. (Co-ordinating Chairman)
Seah Cheng Siang, M.D., F.R.C.P.E., F.R.A.C.P. (Medical Unit, Thomson Road General Hospital)
E. Hanam, M.B., F.R.C.P.E. (Medical Unit I, Outram Road General Hospital)
Beatrice Chen, M.B., M.R.A.C.P. (Medical Unit II, Outram Road General Hospital)
Tham Ngiap Boo, M.B., M.R.A.C.P. (Medical Unit III, Outram Road General Hospital)
Chan Sing Kit, M.B., M.R.C.P., D.C.H. (Paediatric East Unit, Outram Road General Hospital)
Freda Paul, M.B., M.R.C.P.E., D.C.H. (Paediatric West Unit, Outram Road General Hospital)
Lee Siew Khow, M.B., M.R.C.P.E. (Medical Unit, Tan Tock Seng Hospital)
David Tan, M.B. M.R.C.P.G. (Blood Transfusion Services, General Hospital)

TABLE I

INCIDENCE & MORTALITY RATES OF LEUKEMIA
IN SINGAPORE 1961-1965

| Year | Singapore Population* | No. of Cases Discovered | Incidence per 100,000 | No. of Deaths Reported | Mortality per 100,000 |
|------|-----------------------|-------------------------|-----------------------|------------------------|-----------------------|
| 1961 | 1,687.3 | 51 | 3.0 | 38 | 2.2 |
| 1962 | 1,732.8 | 51 | 2.9 | 51 | 2.9 |
| 1963 | 1,775.2 | 63 | 3.5 | 53 | 2.9 |
| 1964 | 1,820.0 | 52 | 2.8 | 56 | 3.1 |
| 1965 | 1,864.9 | 63 | 3.4 | 63 | 3.4 |

*Population in thousands

TABLE II

CLINICAL & MORPHOLOGICAL CLASSIFICATION
OF 280 CASES OF LEUKEMIA

| Year | Total No. of Cases | Chronic Leukemia | | Acute & Subacute Leukemia | | | |
|--------|--------------------|------------------|--------------|---------------------------|---------------|-------------------|-------------|
| | | Lymphocytic | Granulocytic | Lymphoblastic | Meyeloblastic | Miscell. | Unspecified |
| 1961 | 51 | 0 | 13 | 11 | 16 | 2* | 9 |
| 1962 | 51 | 0 | 14 | 17 | 12 | 2+ | 6 |
| 1963 | 63 | 3 | 9 | 15 | 14 | 1* 1 ⁺ | 20 |
| 1964 | 52 | 1 | 11 | 9 | 19 | 1* | 11 |
| 1965 | 63 | 2 | 11 | 12 | 31 | 2+ | 5 |
| Series | 280 (100%) | 6 (2%) | 58 (21%) | 64 (23%) | 92 (33%) | 9 (3%) | 51 (18%) |

*Erythroleukemia
+Monocytic Leukemia

TABLE III

SEX & ETHNIC RATIO IN 280 CASES OF LEUKEMIA

| Race | Total No. of Cases | Male | Female | M : F Ratio |
|---------|--------------------|------|--------|-------------|
| Chinese | 233 | 158 | 75 | 2.1 : 1 |
| Malay | 23 | 17 | 6 | 2.8 : 1 |
| Indian | 13 | 11 | 2 | 5.5 : 1 |
| Others | 11 | 7 | 4 | 1.7 : 1 |
| Series | 280 | 193 | 87 | 2.2 : 1 |

mortality rate but rather a reflection of the better certification of deaths in more recent years.

A point to be noted is that apart for 1961 and 1963, the number of deaths reported each year is approximately the same as the number of new cases discovered for the corresponding year.

CLINICAL AND MORPHOLOGICAL CLASSIFICATION OF LEUKEMIA IN SINGAPORE

Table II shows the clinical and morphological classification of the 280 cases of leukemia documented. 216 cases, or 77% of the series were of the acute variety. Chronic leukemia accounted for 64 cases, or 23% of the series.

Classification of the 216 cases of acute leukemia into morphological types showed that 33% were myeloblastic and 23% lymphoblastic. 3% of cases were of the less common erythroleukemia and monocytic varieties. 18% of the acute leukemias were of unspecified cell type. The great majority of these were cases of childhood leukemia, where it is often difficult to be definite of the cell type. It is probable that the majority of these are of the lymphoblastic variety.

Of the 64 cases of chronic leukemia, 58 or 21% of the series were granulocytic whilst only 6 cases or 2% were of the lymphocytic variety.

INCIDENCE OF LEUKEMIA IN RELATION TO AGE AND SEX

The age distribution of the 216 cases of acute leukemia is shown in Fig. 1. The peak incidence, 35% of the series, occurred in the first decade of life, followed by 27% in the second decade. Approximately 10% of the series were represented in each of the decades between the third and the seventh.

The distribution of acute leukemia patients below 20 years of age is shown in Fig. 2. There appears to be a peak incidence at 4 years and between 11 and 12 years.

The age distribution in 64 cases of chronic leukemia is shown in Fig. 3. The distribution is different from that of acute leukemia with very few patients in the first two decades of life. Thereafter chronic leukemia occurs with increasing frequency with a peak incidence in the sixth decade. There was no apparent explanation for a small number of cases seen between the ages of 40 to 49.

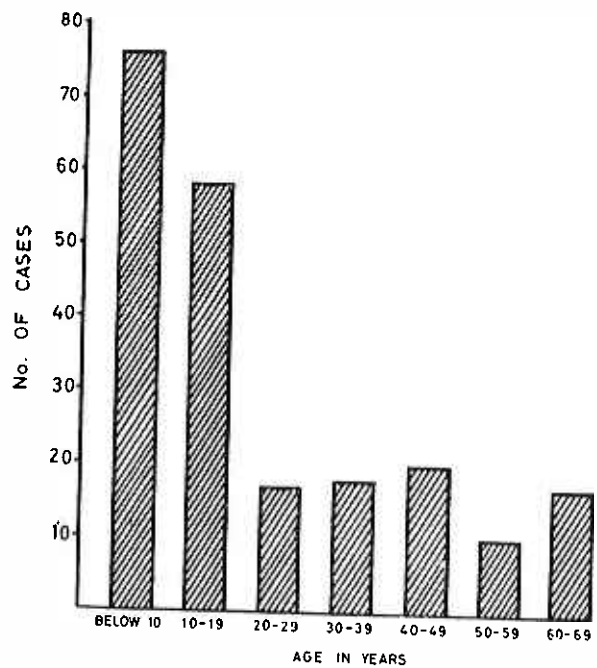


Fig. 1.. Age distribution in 216 Cases of acute leukemia.

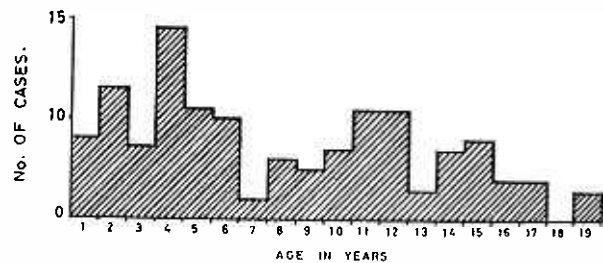


Fig. 2. Age distribution in 134 Cases of acute leukemia below 20 years.

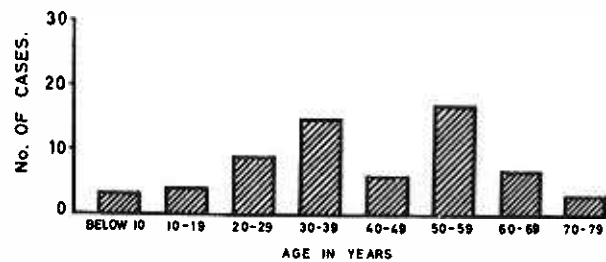


Fig. 3. Age distribution in 64 Cases of chronic leukemia.

Of the 280 cases of leukemia, 193 were males and 87 females, giving a male to female ratio of 2.2:1. Table III.

This predominance of males is seen in patients with acute leukemia 2.0:1, as well as with chronic leukemia 3.0:1. Table IV.

The incidence of leukemia among males ranged from 3.8 to 4.9 per hundred thousand, whilst the incidence among females ranged from 1.6 to 2.7 per hundred thousand. Table V.

TABLE IV
SEX RATIO IN 280 PATIENTS WITH LEUKEMIA

| | Acute Leukemia | | Chronic Leukemia | |
|--------------|----------------|--------|------------------|--------|
| | Male | Female | Male | Female |
| No. of cases | 145 | 17 | 48 | 16 |
| M. F. ratio | 2.0 | : 1 | 3.0 | : 1 |

TABLE V
SEX INCIDENCE OF LEUKEMIA IN SINGAPORE

| Year | Total No. of Male Cases | Population* | Incidence per 100,000 | Total No. of Female Cases | Population* | Incidence per 100,000 |
|------|-------------------------|-------------|-----------------------|---------------------------|-------------|-----------------------|
| 1961 | 35 | 881.2 | 3.9 | 16 | 806.1 | 1.9 |
| 1962 | 37 | 903.3 | 4.1 | 14 | 829.5 | 1.6 |
| 1963 | 46 | 922.7 | 4.9 | 17 | 852.5 | 1.9 |
| 1964 | 36 | 944.7 | 3.8 | 16 | 875.1 | 1.8 |
| 1965 | 39 | 967.5 | 4.0 | 24 | 897.4 | 2.7 |

*Population in thousands

TABLE VI
ETHNIC INCIDENCE OF LEUKEMIA

| Year | CHINESE | | MALAY | | INDIAN | | OTHERS | |
|------|--------------|-----------------------|--------------|-----------------------|--------------|-----------------------|--------------|-----------------------|
| | No. of Cases | Incidence per 100,000 | No. of Cases | Incidence per 100,000 | No. of Cases | Incidence per 100,000 | No. of Cases | Incidence per 100,000 |
| 1961 | 43 | 3.4 | 2 | 0.8 | 2 | 1.4 | 4 | 9.9 |
| 1962 | 43 | 3.3 | 2 | 0.8 | 4 | 2.8 | 2 | 4.6 |
| 1963 | 49 | 3.6 | 8 | 3.2 | 3 | 2.1 | 3 | 6.6 |
| 1964 | 46 | 3.4 | 5 | 1.9 | 1 | 0.7 | — | — |
| 1965 | 52 | 3.7 | 6 | 2.3 | 3 | 2.0 | 2 | 4.1 |

TABLE VII
PROPORTION OF ACUTE & CHRONIC LEUKEMIA IN PATIENTS OF DIFFERENT ETHNIC GROUPS

| Ethnic Group | Acute Leukemia | Chronic Leukemia |
|--------------|----------------|------------------|
| Chinese | 187 (80%) | 46 (20%) |
| Malay | 15 (65%) | 8 (35%) |
| Indian | 8 (62%) | 5 (38%) |
| Other Races | 6 (55%) | 5 (45%) |

ETHNIC DIFFERENCES IN THE INCIDENCE OF LEUKEMIA

The incidence of leukemia among the different ethnic groups in Singapore is shown in Table VI.

The incidence ranged from 3.3 to 3.7 per hundred thousand population for Chinese, 0.8 to 3.2 per hundred thousand for Malays, 0.7 to 2.8 per hundred thousand for Indians and 4.1 to 9.9 per hundred thousand for the Other Races. The exact significance of the apparent low incidence among Malays and Indians compared with the Chinese is uncertain and it is possible that conservatism among the Indians and Malays may be responsible for fewer patients seeking treatment in our hospitals.

The proportion of acute and chronic leukemia was 80% and 20% respectively for Chinese, 65% and 35% for Malays, 62% and 38% for Indians and 55% and 45% for Other Races, Table VII.

The predominance of males over females among patients with acute and chronic leukemia is seen in all ethnic groups, Table III. The male to female ratio was 2.1:1 for Chinese, 2.8:1 for Malays, 5.5:1 for Indians and 1.7:1 for Other Races.

Because of the small number of cases of leukemia among Malays, Indians, and Other Races, it is not possible to make generalisation about age distribution and the relative frequency of the different morphological types of leukemia although our impression is that there were no significant differences in the pattern among the different ethnic groups.

DISCUSSION

Statistics on leukemia may be obtained from an analysis of hospital records, death certificates or from a Central Registry, if the condition is made notifiable. In Singapore, leukemia is not a notifiable disease so that only the first two sources of information are available for analysis.

Analysis of death certificates has its limitations. Firstly, there are the difficulties of diagnostic criteria used by the certifying medical practitioners. Secondly, the Seventh Revision of the International List of the Cause of Death (1955) does not allow a clear subdivision of leukemia into the different clinical and morphological varieties. Thirdly, there is

the possibility that patients with leukemia, especially the chronic variety, may be certified as dying from entirely unrelated causes with no mention of the leukemic pathology. In Singapore, there is the added difficulty that not all deaths are certified by qualified medical practitioners, a good proportion being certified by Health Inspectors and Policemen. Statistics based on death certificates therefore tend to err on the conservative side and are usually an underestimate.

Analysis of hospital records will be more reliable with regard to diagnostic criteria but has the possible limitation that the results may not be entirely representative of the population at risk. This is because of the possibility of selection for age, socio-economic or racial groups or because of the specialised interest of a particular physician in the hospital. However, in view of the fact that every Government Hospital in Singapore was represented in the survey and the Government Medical Service provides approximately 95% of the available hospital beds, it is felt that the figures reported here are representative of the population as a whole.

The survey showed that the overall incidence of leukemia in Singapore is approximately 3.4 per hundred thousand population. The lower mortality rates seen in 1961-1964 is probably due to the factors tending to underestimate the incidence mentioned earlier.

The apparent increase in mortality from 2.2 per hundred thousand in 1961 to 3.4 per hundred thousand in 1965 is probably not a true increase but rather a reflection of the better certification of deaths in more recent years.

The incidence and mortality figure of 3.4 per hundred thousand for 1965 is approximately similar to that reported by Wells and Lau from Singapore for the year 1958, although, they were of the opinion that their figures should be increased by 33% for a more accurate comparison of mortality rates reported by other countries.

Our results would indicate that since 1958 there has been no further increase in the incidence of leukemia in Singapore and that whatever factors were responsible for the apparent rise in mortality between 1949 to 1958 were no longer operative.

Our results also suggest that leukemia is less common in Singapore than in countries like the United States, United Kingdom, Aus-

tralia and New Zealand, Denmark and other European countries. The incidence is higher than that reported from Japan, W.H.O. 1960. Although it has often been suggested that the lower rate in non-European countries is due to inadequate medical facilities and difficulties in diagnosis, these reasons are not applicable in Singapore where medical facilities are well-developed and are readily available to the whole population.

The high incidence of leukemia, almost approaching that of European countries, among the Other Races, mainly Eurasian and British, is to be noted. There were no apparent reasons for the higher incidence among this group apart from the possibility that there is better case finding among the group who as a whole are better educated and belong to a higher socio-economic group.

An analysis of the series of leukemia cases into acute and chronic varieties gives results very similar to that reported by Wells and Lau, 1960. Our results further confirm the relative rarity of chronic lymphocytic leukemia among the Singapore population, a characteristic that has similarly been observed in Japan and India.

Leukemia is more common among males than among females and this is reflected in the male: female ratio of 2:1 and in the higher incidence rate of approximately 4.5 per hundred thousand for males compared to 2.0 per hundred thousand for females. This predominance is seen in all ethnic groups irrespective of the clinical variety or of the morphological type. A similar sex distribution is seen in leukemia reported from other countries. The predominance of males is even more marked among Indians, 5.0:1, and may be explained by the fact that there are approximately twice the number of Indian men than women in Singapore, whereas among the

other ethnic groups the proportion of men to women is approximately the same.

SUMMARY

The incidence of leukemia in Singapore is approximately 3.4 per hundred thousand.

There is no evidence to suggest any increase in the incidence or mortality from leukemia in Singapore over the past 5 years (1961-1965).

Acute leukemia is the commonest form of leukemia encountered, accounting for approximately 77% of the total series and is commonest in the first decade of life.

Chronic leukemia is generally less common and affects adults mainly in the sixth decade of life.

There is a predominance of males over females among patients with all forms of leukemia.

There do not appear to be any significant differences in the pattern of leukemia, among the 3 major ethnic groups in Singapore, the Chinese, Malays and Indians.

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