Chapter 29
Leukemia

Marie-Josephe D. Horner and Lynn A.Gloeckler Ries

INTRODUCTION

Leukemias are malignancies that affect the blood-forming stem cells found in bone marrow. Myeloid leukemias are cancers that arise from myeloid stem cells, which normally mature into red blood cells, white blood cells, and platelet-producing cells. Lymphoblastic leukemias are cancers that arise from lymphocyte stem cells, which normally mature into white blood cells, also known as leukocytes. Leukemias are a heterogeneous group of cancers in terms of both biological and clinical features. Acute types refer to cancers arising in immature stem cells, while chronic types refer to cancers arising in mature stem cells.

Acute leukemias have been linked with several occupational and environmental exposures, and certain carcinogenic therapies. Radiation from the atom bomb (1) has been associated with an increased risk for acute lymphoblastic leukemia (ALL) and acute myeloid leukemia (AML), but not for chronic leukemias. The risk from low-dose radiation seen in occupational settings (2) and from electromagnetic fields (3, 4) is controversial. Smoking has been linked to acute leukemia (5-7). As much as 20% of AML cases may be due to smoking (6). Certain chemotherapy agents are associated with an increased risk of secondary leukemias, in particular AML, following treatment for ALL (8-10) and Hodgkin lymphoma (11).

The average age-adjusted incidence for leukemia during the period 1975-2003 is 12.8 per 100,000 persons (12). The American Cancer Society (ACS) estimates that in 2006 there will be 35,070 leukemias diagnosed in the United States: 13,950 lymphoblastic leukemias, 16,430 myeloid leukemias, and 5,690 "other" leukemias (13). Leukemias considered together are one of the top 10 cancers in the United States.

ACS shows the most common leukemia to be acute myeloid leukemia (AML) (11,930 cases) followed by chronic lymphoblastic leukemia (CLL) (10,020 cases) (13). The incidence of the different types of leukemia, varies by age. When age-adjusted rates were used CLL had the highest incidence rate, 4.3 per 100,000 (12), compared to 3.4 per 100,000 for acute myeloid leukemia (AML), 1.8 per 100,000 for chronic myeloid leukemia (CML), and 1.3 per 100,000 for acute lymphoblastic leukemia (ALL) in 1975-2003. The 2000-2003 average incidence of all leukemias in persons over 65 years of age was 54.8 per 100,000 compared to 6.0 for persons less than 65 years. However, of all types of leukemia, acute lymphoblastic leukemia impacted children and young adults the most. Acute lymphoblastic leukemia was responsible for more deaths in this age group than any other cancer site. The median age at diagnosis for ALL was 13 years and 61.1% of incident cases for 2000-2003 occurred in children/young adults <20 years of age (12).

This chapter provides survival analysis for 42,678 histologically confirmed cases of primary leukemia diagnosed from 1988 through 2001 from the Surveillance, Epidemiology, and End Results (SEER) Program of the National Cancer Institute (NCI). This chapter highlights the influence of type of leukemia, race and ethnicity, age, and sex on survival outcomes.

MATERIALS AND METHODS

Exclusions

Analyses for all categories of leukemia, with the exception of acute lymphoblastic leukemia, included patients aged 20 years or over diagnosed with leukemia between 1988 and 2001 and reported to the SEER program. Analysis for acute lymphoblastic leukemia also included cases less than 20 years of age, since children and young adults represent nearly two-thirds of cases for this histological type and since their incidence and survival differ from those of adults. Patients were followed for vital status until 2002. Patients with unknown race, death certificate only cases, those without histologic confirmation of a leukemia diagnosis, or those alive with no survival time were excluded from analysis. Table 29.1 details the counts for these exclusions with 42,678 cases for analyses.

Table 29.1: Leukemia: Number of Cases and Exclusions by Reason, 12 SEER Areas, 1988-2001

Number selected/remaining	Number excluded	Reason for selection/exclusion
54,899	-	Diagnosed 1988-2001 (Los Angeles for 1992-2001 only)
47,631	7,268	Select first primary only
46,486	1,145	Exclude death certificate only or at autopsy
46,083	403	Exclude unknown race
46,009	74	Exclude alive with no survival time
44,667	1,342	Exclude children (Ages 0-19, except for Acute Lymphocytic Leukemia
44,667	0	Exclude in situ cancers
44,667	0	Exclude sarcomas
42,678	1,989	Exclude no or unknown microscopic confirmation

The survival analysis was based on relative survival rates calculated by the life-table method (14).The relative rate was used to estimate the effect of cancer on the survival of the cohort. Relative survival, defined as the ratio of observed survival to expected survival, adjusts for the expected mortality that the cohort would experience from other causes of death.

Histologic classification

Leukemia is a heterogeneous group of malignancies. Multiple classification schemes have been developed over the past several decades. The 1988-2000 data were collected using the International Classification of Diseases for Oncology, second edition (ICD-O-2) schema (12) and the 2001 data use the International Classification of Diseases for Oncology, third edition (ICD-O-3) (15). The French-American-British (FAB) classification of leukemias uses cytogenetic and molecular elements and has been included in the latest ICD edition, ICD-O-3, which was implemented in 2001 (15). We used the ICD-O-2 to ICD-O-3 conversion tables to create histologic groupings that are more reflective of the current World Health Organization classification of hematopoietic diseases.

Leukemia subtypes generally fall into one of the major cell type groups and will be analyzed as such: acute lymphoblastic leukemia (ALL), chronic lymphoblastic leukemia (CLL), "other" lymphoblastic leukemia, acute myeloid leukemia (AML), acute monocytic leukemia, chronic myeloid (or granulocytic) leukemia (CML), "other" myeloid/monocytic leukemia, "other" acute leukemia, and aleukemic, subleukemia, not otherwise specified (NOS) leukemia(12). Histologic categories, with their associated ICD-O-3 codes, are summarized in table 29.2.

RESULTS

Histology

For each type of leukemia, there was a slightly higher proportion of men than women, except for "other" lymphocytic leukemia where nearly three-fourths were men. The age distribution at diagnosis for adults with leukemia varies widely by type of leukemia. For example, the percentage 75 years of age and over ranged from 14.1% of adults with ALL to over 35% for CLL, "other" myeloid/

Table 29.2: Leukemia: Number of Cases by Histology, Ages 20+, 12 SEER Areas, 1988-2001

Histology Group	Histology (ICD-O Code)	Cases
Lymphocytic Leukemia	Children and young adults 0-19 years Acute Lymphocytic Leukemia (9826,9835-9837)	4,418
	Adults 20+ years Acute Lymphocytic Leukemia (9826,9835-9837)	2,312
	Chronic Lymphocytic Leukemia (9823)	13,145
	Other Lymphocytic Leukemia (9820,9832-9834, 9940)	1,686
Myeloid and Monocytic Leukemia	Acute Myeloid Leukemia (9840,9861,9866,9867,9871-9874, 9895-9897, 9910, 9920)	11,459
	Acute Monocytic Leukemia (9891)	738
	Chronic Myeloid Leukemia (9863,9875, 9876, 9945,9946)	6,028
	Other Myeloid/Monocytic Leukemia (9860,9930)	507
Other Leukemia	Other Acute Leukemia (9801, 9805, 9931)	1,474
	Aleukemic, Subleukemic and NOS (9733,9742, 9800, 9827,9831, 9870, 9948, 9963-9964)	911
Total		42,678

Table 29.3: Number and Distribution of Cases by Sex, Race, Age at Diagnosis (20+, except for Acute Lymphocytic Leukemia) and Histology, 12 SEER Areas, 1988-2001

Characteristics	Histology									
	Acute Lymphocytic Leukemia				Chronic Lymphocytic Leukemia		Other Lymphocytic Leukemia		Acute Myeloid Leukemia	
	0-19 years		>20 years		All Ages 20+					
	Cases	Percent	Cases	Percent	Cases	Percent	Cases	Percent	Cases	Percent
Total	4,418		2,312		13,145		1,686		11,459	
Sex										
Male	2,509	56.8	1,357	58.7	7,801	59.3	1,231	73.0	6,240	54.5
Female	1,909	43.2	955	41.3	5,344	40.7	455	27.0	5,219	45.5
Race*										
White	3,681	83.3	1,943	84.0	11,997	91.3	1,548	91.8	9,607	83.8
Black	298	6.7	150	6.5	851	6.5	72	4.3	814	7.1
Age at diagnosis (Years)										
20-39	N/A	N/A	887	38.4	143	1.1	139	8.2	1,536	13.4
40-59	N/A	N/A	665	28.8	2,754	21.0	645	38.3	2,675	23.3
60-74	N/A	N/A	433	18.7	5,611	42.7	523	31.0	3,869	33.8
75+	N/A	N/A	327	14.1	4,637	35.3	379	22.5	3,379	29.5

* Relative survival rate for "other" race not calculated

Table 29.3: (continued)

Characteristics	Histology									
	Acute Monocytic Leukemia		Chronic Myeloid Leukemia		Other Myeloid/ Monocytic Leukemia		Other Acute Leukemia		Aleukemic, Subleukemic and NOS	
	All Ages									
	Cases	Percent	Cases	Percent	Cases	Percent	Cases	Percent	Cases	Percent
Total	738		6,028		507		1,474		911	
Sex										
Male	435	58.9	3,499	58.0	287	56.6	800	54.3	491	53.9
Female	303	41.1	2,529	42.0	223	44.0	674	45.7	420	46.1
Race*										
White	646	87.5	5,010	83.1	419	82.6	1,268	86.0	762	83.6
Black	42	5.7	553	9.2	50	9.9	102	6.9	96	10.5
Age at diagnosis (Years)										
20-39	99	13.4	995	16.5	39	7.7	115	7.8	59	6.5
40-59	191	25.9	1,588	26.3	81	16.0	197	13.4	123	13.5
60-74	231	31.3	1,774	29.4	182	35.9	472	32.0	310	34.0
75+	217	29.4	1,671	27.7	205	40.4	690	46.8	419	46.0

* Relative survival rate for "other" race not calculated

Table 29.4: Acute Lymphocytic Leukemia: Number of Cases and 1-, 3-, 5- and 10-Year Relative Survival Rates (%) by Sex, Age (20+), and Race, 12 SEER Areas, 1988-2001

Characteristics	Cases	Relative Survival			
		1-Yr	3-Yr	5-Yr	10-Yr
Total	6,730	79.8	66.7	62.2	60.1
Sex					
Male	3,866	79.9	65.7	60.9	58.6
Female	2,864	79.7	68.1	64.1	61.9
Age (Years)					
0-19	4,418	94.5	85.3	80.2	76.5
20-39	887	70.8	43.4	37.3	33.4
40-59	665	55.5	28.0	22.0	17.2
60-74	433	29.4	14.1	9.9	5.9
75+	327	16.1	5.8	4.0	3.3
Race					
White	5,624	80.1	67.3	63.2	60.9
Black	448	77.1	59.1	51.7	49.3
Race/Sex					
White males	3,235	80.2	66.3	61.8	59.6
White females	2,389	79.8	68.7	65.1	62.6
Black males	245	78.5	59.6	52.0	47.8
Black females	203	75.3	58.6	51.2	50.1

Table 29.5: Chronic Lymphocytic Leukemia: Number of Cases and 1-, 3-, 5- and 10-Year Relative Survival Rates (%) by Sex, Age (20+) and Race, 12 SEER Areas, 1988-2001

Characteristics	Cases	Relative Survival Rate (%)			
		1-Yr	3-Yr	5-Yr	10-Yr
Total	13,145	92.3	86.7	74.9	54.2
Sex					
Male	7,801	92.3	83.7	75.5	52.5
Female	5,344	91.4	83.4	75.4	56.5
Age (Years)					
20-39	143	94.6	86.7	83.4	64.8
40-59	2,754	97.0	90.0	82.6	60.8
60-74	5,611	95.0	86.6	78.0	55.4
75+	4,637	85.7	74.4	62.0	40.0
Race					
White	11,997	92.8	84.7	76.3	56.1
Black	851	86.2	71.4	58.0	30.0
Race/Sex					
White males	7,120	93.4	85.1	76.3	54.7
White females	4,877	92.0	84.1	76.3	58.0
Black males	490	87.5	68.9	53.1	25.7
Black females	361	84.2	74.9	64.5	35.1

Table 29.6: Acute Myeloid Leukemia: Number of Cases and 1-, 3-, 5- and 10- Year Relative Survival Rates (%) by Sex, Age (20+) and Race, 12 SEER Areas, 1988-2001

Characteristics	Cases	Relative Survival Rate (%)			
		1-Yr	3-Yr	5-Yr	10-Yr
Total	11,459	34.4	18.9	16.5	16.1
Sex					
Male	6,240	33.7	17.7	15.1	14.8
Female	5,219	35.3	20.2	18.0	17.2
Age (Years)					
20-39	1,536	67.3	46.2	42.1	38.3
40-59	2,675	50.6	29.6	25.1	21.7
60-74	3,869	29.0	11.0	7.3	5.3
75+	3,379	11.0	2.9	1.9	0.8
Race					
White	9,607	34.1	18.7	16.3	15.8
Black	814	34.7	17.0	14.5	13.1
Race/Sex					
White males	5,276	33.6	17.3	15.0	14.6
White females	4,331	34.7	20.2	17.8	17.1
Black males	395	34.6	18.3	14.6	11.1
Black females	419	34.8	15.7	14.2	14.2

Table 29.7: Acute Monocytic Leukemia: Number of Cases and 1-, 3-, 5-and 10-Year Relative Survival Rates (%) by Sex, Age (20+) and Race, 12 SEER Areas, 1988-2001

Characteristics	Cases	Relative Survival Rate (%)			
		1-Yr	3-Yr	5-Yr	10-Yr
Sex					
Male	435	30.8	17.0	15.1	13.6
Female	303	26.2	14.7	13.2	12.1
Age (Years)					
20-39	99	43.3	30.9	24.4	24.4
40-59	191	45.3	24.9	22.2	21.4
60-74	231	26.2	11.7	9.0	3.3
75+	217	9.1	2.9	2.9	!
Race					
White	646	29.5	16.4	15.2	13.7
Black	42	24.6	19.8	11.1	11.1
Race/Sex					
White males	386	31.9	17.4	16.0	14.0
White females	260	26.1	14.9	13.7	12.7
Black males	19	~	~	~	~
Black females	23	~	~	~	~

~ Statistic not displayed due to less than 25 cases

Figure 29.1: Leukemia: Relative Survival Rates (%) by Histology, Ages 20+ plus Acute Lymphoblastic Leukemia for Ages 0-19, 12 SEER Areas, 1988-2001

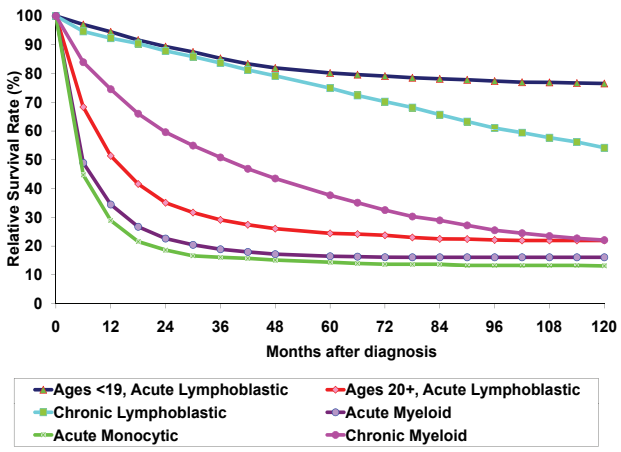


Figure 29.2:"Other" Leukemia: Relative Survival Rates (%) by Histology, Ages 20+, 12 SEER Areas, 1988-2001

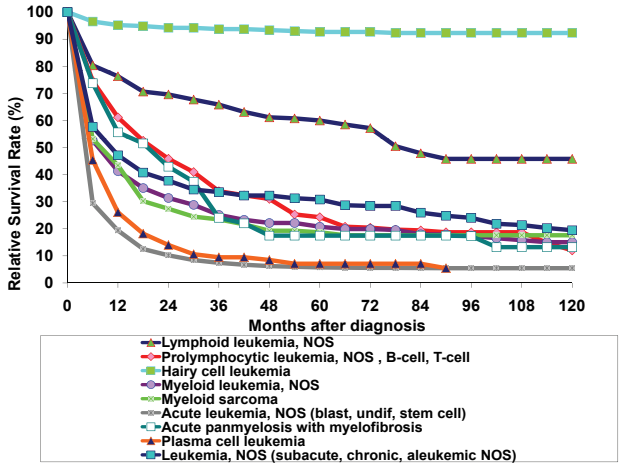


Figure 29.3: Acute Lymphocytic Leukemia: Relative Survival Rates (%) by Race and Sex, Ages 0-19, 12 SEER Areas, 1988-2001

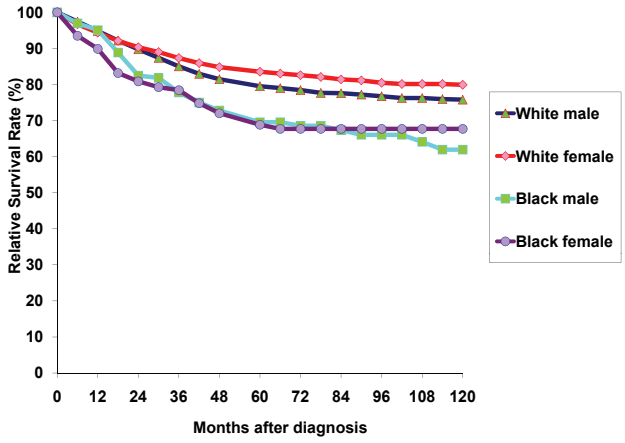
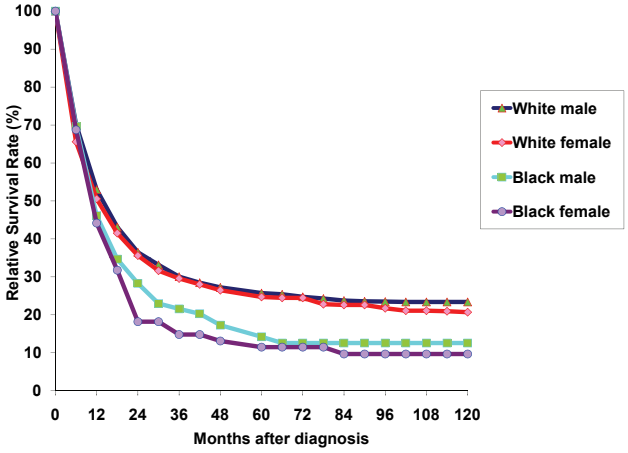


Figure 29.4: Acute Lymphocytic Leukemia: Relative Survival Rates (%) by Race and Sex, Ages 20+12 SEER Areas, 1988-2001



monocytic, "other" acute, and aleukemic leukemia (Table 29.3). One-, three-, five-, and ten-year relative survival rates, are presented in tables by type of leukemia: ALL (Table 29.4), CLL (Table 29.5), AML (Table 29.6), acute monocytic (Table 29.7), CML (Table 29.8) and other leukemias including "other" lymphocytic, "other" myeloid, "other" acute, and aleukemic, subleukemic, and not otherwise specified (NOS) (Table 29.9).

Lymphoblastic leukemias, notably CLL, have the most favorable survival outcomes during the first twelve months following diagnosis. The 1-year relative survival rates for CLL and ALL were 92% and 80%, respectively (Tables 29.4, 29.5, 29.9; Figure 29.1). Myeloid and monocytic leukemias have the least favorable survival rates during the first year following diagnosis, with a 1-year relative survival rate of 34% for AML, 30% for acute monocytic, and 76% for CML (Tables 29.6-29.7; Figure 29.1).

Five years after diagnosis, patients with CLL and ALL still fared better than those diagnosed with myeloid and monocytic types of leukemia. The 5-year relative survival rates for CLL and ALL were 75% and 62% respectively, compared to 38% and 17% for CML and AML (Tables 29.4-29.8). Figure 29.1 shows the 10-year relative survival curves for distinct histological types of leukemia.

"Other" lymphoblastic leukemia had the most favorable among "other" types of leukemia, for 1- and 5- years after diagnosis (Table 29.9). The 1-year survival rate for "other" lymphoblastic leukemia is 88%, while that of "other" myeloid is 42% and that of aleukemic, subleukemic, and

Table 29.8: Chronic Myeloid Leukemia: Number of Cases and 1-, 3-, 5-and 10-Year Relative Survival Rates (%) by Sex, Age (20+) and Race, 12 SEER Areas, 1988-2001

Characersitics	Cases	Relative Survival Rate (%)			
		1-Year	3-Year	5-Year	10-Year
Total	6,028	75.5	50.8	37.7	22.1
Sex					
Male	3,499	75.5	50.4	37.4	23.0
Female	2,529	74.6	51.4	38.1	20.8
Age (Years)					
20-39	995	89.8	65.3	55.0	41.1
40-59	1,588	86.3	63.1	48.1	29.6
60-74	1,774	71.9	46.7	30.5	8.6
75+	1,671	55.5	30.0	16.9	2.9
Race					
White	5,010	74.2	50.6	37.6	21.7
Black	553	76.6	49.8	36.6	20.9
Race/Sex					
White males	2,901	74.1	50.2	37.4	22.9
White females	2,109	74.3	51.2	38.0	20.1
Black males	320	77.0	49.6	34.1	20.0
Black females	233	76.1	50.0	39.8	21.9

Table 29.9: "Other" leukemias: Number of Cases and 1-, 3-, 5- and 10-Year Relative Survival Rate (%) by Histology, Ages 20+, 12 SEER Areas, 1988-2001

Histology	Cases	Relative Survival Rate (%)			
		1-Year	3-Year	5-Year	10-Year
"Other" lymphocytic	1,686	87.7	81.8	79.5	77.5
Lymphoid leukemia, NOS	238	76.3	65.8	60.0	45.8
Prolymphocytic, NOS [3]	249	61.5	33.9	24.3	12.0
Hairy cell leukemia	1,199	95.2	93.7	92.7	92.3
Other myeloid	507	41.7	24.8	20.3	15.8
Myeloid leukemia, NOS *	400	41.3	25.1	20.8	15.1
Myeloid sarcoma	107	43.4	23.5	18.7	17.6
Other acute	1,474	21.1	8.3	6.4	6.2
Acute leukemia, NOS[1]	1,402	19.4	10.2	5.8	5.5
Acute panmyelosis with myelofibrosis	65	55.6	24.0	17.5	13.2
Aleukemic, Subleukemic, and NOS*	911	45.1	30.0	27.1	17.3
Leukemia, NOS[4]	712	47.1	33.6	30.8	19.5
Plasma cell leukemia	103	26.1	9.5	7.1	!

*NOS, not otherwise specified
[1] Blast cell, undifferentiated, Stem cell
[2] Subacute NOS, Chronic NOS, Aleukemic NOS
[3] Includes Prolymphocytic B-cell, Prolymphocytic T-cell
[4] Subacute NOS, Chronic NOS, Aleukemic NOS
! Not enough intervals to produce rate

NOS is 45%. "Other" acute leukemia fares the worst 1-year after diagnosis, with a 1-year survival rate of 21%. These differences in survival widen 5 and 10 years after diagnosis.

In terms of specific histologies in "other" lymphoblastic leukemia, hairy cell leukemia had the most optimistic survival rates, 1-year (95%) and 5-years after diagnosis (93%), compared to lymphoid leukemia, NOS, and prolymphocytic leukemia, NOS (Table 29.9). Figure 29.2 shows the relative survival of specific histologies for "other" lymphoblastic, "other" myeloid leukemia, "other" acute leukemia, and aleukemic, subacute and NOS leukemia.

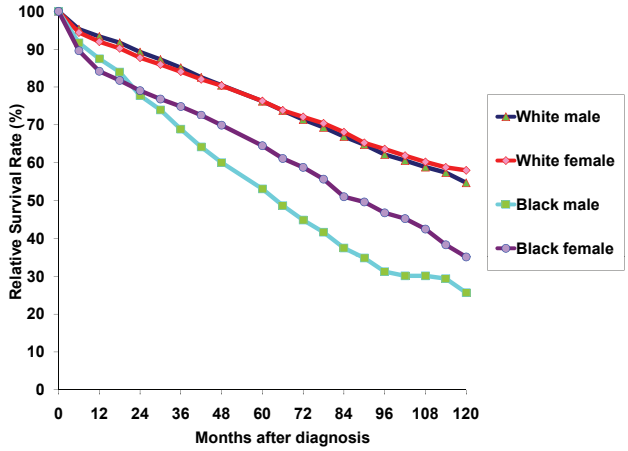
Age at diagnosis

Patient age at diagnosis strongly influences survival patterns after leukemia diagnosis. Increasing age at diagnosis had a general linear association with poorer survival over 10 years after diagnosis for all categories of leukemia. These differences in relative survival become more apparent with increasing time since diagnosis.

Lymphoblastic leukemias

Approximately two-thirds of persons diagnosed with acute lymphoblastic leukemia were children and young adults. The survival among those less than 20 years of age is distinctly higher than the survival in any other age group (Table 29.4). As age of diagnosis increases, survival de-

Figure 29.5: Chronic Lymphocytic Leukemia: Relative Survival Rates (%) by Race and Sex, Ages 20+, 12 SEER Areas, 1988-2001



clines. The 1-year relative survival rate in ALL patients aged 0-19 years is 95%, while the same 1-year survival rate in 20-39 year olds is 71%. In the two oldest age groups, 60-74 and 75+ years of age, the 1-year survival rate is 29% and 16%, respectively. These large differences by age remain pronounced over the three, five, and ten year period following diagnosis.

Chronic lymphoblastic leukemia had the best overall survival for all age groups. At 12 months after diagnosis, the difference between the relative survivals among age groups is not pronounced until 10 years after diagnosis (Table 29.5). The 1-year survival rates for CLL is slightly more favorable for patients diagnosed at 40-59 years (97%) compared to those diagnosed at 20-39 years (95%), 60-74 (95%) and 75+ years of age (86%). However, as with ALL, the long-term survival patterns favor those diagnosed at a younger age. The 5- and 10-year relative survival rates were highest among patients diagnosed at 20-39 years (5-year, 83%; 10-year, 65%) compared to patients diagnosed at 75+ years (5-year, 62%; 10-year, 40%).

Myeloid and monocytic leukemias

The 1-year survival rate for acute myeloid leukemia was most favorable for those in the 20-39 years age group (67%), compared to those in the 75+ age group (11%). This discrepancy persists over 5- and 10-year period following diagnosis (Table 29.6). Similarly for acute monocytic, the survival rates vary greatly between the youngest age group and the oldest; the 1-year relative survival rate was 43% for 20-39 and only 9% for those 75 years and older. For acute monocytic leukemia the survival rates were similar for ages 20-39 and 40-59 (Table 29.7).

The survival curves for chronic myeloid leukemia were very similar for 20-39 and 40-59 age groups for years 1 through 5, after which they slightly diverge, with the 40-59 age group faring slightly worse than their younger counterparts. Overall, the lowest survival rate was found in the age group of 75+, and becomes more pronounced over the long-term. The 1-year survival rate for persons in age groups 20-39 and 40-59 years was 90% and 86% compared to 56% for the 75+ age group. The 5-year relative survival rate for persons in age groups 20-39 and 40-59 years was 55% and 48% compared to 17% for the 75+ age group (Table 29.8).

Histology, gender, and race

Lymphoblastic leukemias

Overall, whites had more favorable 5-year survival rates for childhood lymphoblastic leukemias (Figure 29.3) than black children. Adult lymphoblastic leukemias (5-year ALL, 63%; CLL, 76%) had more favorable 5-year survival rates than blacks (5-year ALL, 52%; CLL, 58%) (Figures 29.4 and 29.5, respectively). The gender difference slightly favored females diagnosed with ALL (5-year survival rate, 64%; males 5-year survival 61%) was not seen among persons diagnosed with CLL (male 5-year survival rate 76%; female 5-year survival rate 75%). Within racial categories, the female survival advantage in survival became more apparent, but was limited to whites (Tables 29.4, 29.5).

Myeloid and monocytic leukemias

Whites diagnosed with myeloid and monocytic leukemias had a slight 5-year survival advantage (5-year survival rates: AML,16%; acute monocytic, 15%, CML, 38%) compared to blacks (5-year AML, 15%; acute monocytic, 11%; CML, 37%). Females also showed a slight 5-year survival advantage compared to males (Tables 29.6, 28.7).

DISCUSSION

These population-based data were based on 42,678 adult leukemia cases diagnosed between 1988 and 2001. While the SEER data provide a large representative sample to examine numerous demographic predictors of survival after diagnosis with leukemia, data were not available on treatment differences and comorbidity, two additional factors that impact survival and could explain some of the patterns we observed. These analyses provide evidence of the considerable variation in survival patterns for leukemia patients, reflecting the heterogeneity of this disease entity.

Leukemia had a combined incidence of 12.2 per 100,000 per year for the period 2000-2003 (12). Relative survival estimates show distinct differences between histologic groups. Survival outcome varies widely between groups, with the lymphoblastic leukemias having the highest 5-year relative survival rates, in particular childhood and young adult ALL (80%). There were large differences in survival by age-group. The older the patient's age was at diagnosis, the lower the relative survival curve for all histology groups. Older patients also had a greater incidence of the cytogenetic abnormalities associated with poor prognosis, namely the Philadelphia chromosome found in cases of ALL (16). Previous reports on AML

indicate that age is inversely associated with cancer remission (17, 18).

The incidence in men is 15.9 per 100,000, while that of women is lower, at 9.4 per 100,000. Overall, there is little gender difference in survival. By race, whites had a higher incidence (12.7 per 100,000) than blacks (10.1 per 100,000). Survival varies by race and gender, but these differences were most pronounced for lymphoblastic leukemias, especially at the 5- and 10-year period after diagnosis. In general, black males and black females tended to fare worse than white males and females. As with other cancer sites, some of these differences in survival outcomes may be due to issues related to access to care and socioeconomic status.

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