Acute Myelogenous Leukemia with an 8;21 Translocation

A Report on 148 Cases from the Groupe Français de Cytogénétique Hématologique

Groupe Français de Cytogénétique Hématologique

ABSTRACT: *A retrospective study of 148 previously untreated patients with acute nonlymphocytic leukemia (ANLL) presenting a t(8;21) was undertaken by the Groupe Français de Cytogénétique Hématologique (GFCH). The mean age was 30.8 years for 33 children and 115 adults, 80% of patients were under 50 years, and 66% were males. The sex ratio was unbalanced only in adults ($p < 0.05$). Morphologic diagnosis was M2 in 92% of patients. Normal and abnormal mitoses were found in 45% of cases. Complex variant translocations involving 8q22, 21q22, and another chromosome had a frequency of 3.4%. In 75% of the cases additional chromosomal abnormalities were observed. Sex chromosome loss was found (73% of additional abnormalities) in 41% of females and 61% of males. Trisomy 8 was the other recurrent numerical abnormality (7.5%). Chromosome 9 was frequently involved in additional abnormalities (11%), mainly in deletions overlapping the region 9q21-22. Deletions or translocations of chromosome 7(q) were observed in 10% of the cases. The order of appearance did not follow a precise pattern. The remission rate was 90.7%. It was similar in males and females, children and adults. The median survival duration from diagnosis was 17.5 months, with a 24% probability of 5 year survival. Children had a median survival of 24 months from diagnosis, which is to be compared to 16 months for the adults (not statistically different). In no cytogenetic category was a white cell count level higher than 10.10^9/L associated with a poorer prognosis. It was concluded that despite the high complete remission rate in t(8;21) ANLL, when a comparison is made between patients achieving a complete remission, the 17-month median survival is similar to that reported in recently published series of ANLL.*

INTRODUCTION

Among the various chromosomal abnormalities found in acute myelogenous leukemia, the t(8;21)(q22;q22) translocation is highly correlated with a specific phenotype [1–5] that is classified M2 in the FAB nomenclature [6–8]. It represents only 7–8% of the acute nonlymphocytic leukemias (ANLL) [9, 10]. The t(8;21) translocation is often associated with loss of a sex chromosome, the Y in males [11, 12] and the inactive X in females. Other chromosomal abnormalities, called secondary, such as partial or total monosomy of chromosome 7 [13–15] and deletion of the long arm of chromosome 9 have been reported [3, 9, 16]. In short-term bone marrow or blood

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cultures, it is not unusual to find a mixture of normal and abnormal karyotypes [5]. The clinical significance of the t(8;21) with regard to prognosis at the present time remains unclear. Although several reports have claimed a good prognosis [3, 12, 13], others have not [17]. In an attempt to answer that question the Groupe Français de Cytogénétique Hématologique (GFCH) decided to collect cases of t(8;21) in a retrospective study.

MATERIALS AND METHODS

Patients

The study included 148 previously untreated ANLL patients who were examined between 1972 and 1987 and presented with a t(8;21). The mean age was 30.8 years, with a range of 3–76 years; 80% of the patients were under 50 years of age. There were 33 children (under 16) and 115 adults. One hundred patients were males (66%). Sex distribution was different in children and adults: 17 males and 16 females in children versus 83 males and 32 females in adults ($p < 0.05$) (Table 1).

After review, morphologic diagnosis was M1 in nine patients, M1/M2 in five patients, M2 in 131 patients, M4 in two patients, and unclassified in one. The mean leucocyte count was 22.10^9/L with a range of $2.2–135.10^9$/L. The mean platelet count was 51.10^9/L with a range of $4–410.10^9$/L. The mean percentage of myeloblasts in peripheral blood was 52%, while the mean percentage of myeloblasts in bone marrow was 64%. Chloromas were found in six cases and were not observed in 42 patients.

Procedure

Bone marrow samples from patients were examined at diagnosis with a direct method and/or following short-term culture. Chromosomal examination was done on bone marrow samples in 94% of the patients, and after a short-term culture (24 or 48 hours) in 92% of the cases. Karyotypes of blood cells cultivated for 24–72 hours without mitogen were prepared in 46 cases (31%). In 38 of these cases, the bone marrow was also examined, thus leaving eight cases with a cytogenetic identification made only on peripheral blood cell metaphases. A 72-hour phytohemagglutinin (PHA) stimulated blood culture was done in several cases. All chromosome analyses were done with banding techniques (RHG or GTG in most cases, with some laboratories using QFQ or RHA). Chromosomal abnormalities are described according to the ISCN [18]. Abnormal clones were defined following the rules of the International Workshops on Chromosomes in Leukemia [9, 11]. When possible, karyotypes obtained in relapse were included in the study. Most cytologic slides were reviewed by the Groupe de Morphologie Hématologique and classified according to the FAB

Table 1 Characteristics of the t(8;21) population

	Children (<16 yr, $n = 33$)	Adults ($n = 115$)	
Sex	17M/16F	83M/32F	$p < 0.05$
Loss of X	5/16	15/32	NS
Loss of Y	13/17	48/83	NS
Additional structural rearrangement	10	31	

Table 2 Complex variant translocations of the t(8;21)

Case	Age	Karyotype
141	11	46,XX,t(8;21;5)(q22;q22;q31)
131	14	45,X,−Y,t(6;8;21)(q21;q22;q22)
135	19	56,XX,t(8;15;21)(q22;q21;q22)
136	46	46,XY/45,X,−Y,t(8;19;21)(q21;p13;q21-22)
43[a]	72	46,XY/47,XY,+min(variation)/45,X,−Y,−15,del(8)(q22),del(21)(q22), +r(15)der(15;21)

[a] Reported in [122].

system [6, 7]. The criteria of inclusion in the study were previously untreated ANLL at diagnosis, and the existence of a clone with a t(8;21) found among at least 15 R- or G-banded metaphases. Twenty-five cytogenetic laboratories (21 French, three Belgian, and one German) participated in this retrospective study. All karyotypes were reviewed in plenary sessions of the GFCH. Analysis of survival was studied with the Kaplan-Meier method and the log-rank method [19, 20]. The χ^2 test was also applied [21].

RESULTS

Cytogenetics

No difference was observed in the percentage of abnormal cells in the bone marrow and blood samples after short-term culture. Normal karyotypes (AN) were present in 68 cases (45%) and abnormal mitoses (AA) in 55% of cases. No constitutional aberration was found. In 23 patients examination of direct bone marrow and bone marrow short-term cultures was performed. In nine of these cases there was an increase in the proportion of abnormal cells after bone marrow culture compared to the direct technique. In seven cases, no abnormal clone was found with the direct technique, but t(8;21) cells were found after short-term culture.

A variant of t(8;21) involving a third chromosome (Table 2) was found in five cases. The third partners were either chromosome 15 (two cases, but at different breakpoints) or one of chromosomes 5, 6, or 19 (one case of each). Chromosome Y was missing in the three male patients with a variant translocation.

The presence of an additional chromosomal abnormality occurred in 111 cases (75%). A numerical abnormality was found in 95 of these patients (86% of cases with additional anomalies). Loss of a sex chromosome was observed in 81 cases (55% of all cases; 73% of those cases showing additional abnormalities). An X chromosome was lost in 41% of females (20 cases), and in ten cases (50%) it was associated with other abnormalities (Table 1). The Y chromosome was lost in 61% of men and, in ten cases out of 61 (18%), it was associated with other secondary abnormalities. Sex chromosome loss mosaicism in t(8;21) cells was observed in two females (20% of females) and 11 males (18% of males) (Table 3). In 16 cases losses or gains of autosomes were found (Table 4). The only recurrent anomaly was trisomy 8, which occurred as the sole additional anomaly in five cases and was associated with other abnormalities in seven other cases. The nontranslocated chromosome 8 was always involved.

Additional structural chromosomal rearrangements were found in 41 patients (28% of all patients, 37% of patients with additional abnormalities) (Table 4). Chro-

Table 3 Loss of sex chromosomes with an acquired mosaicism

Case	Karotype
1, 2, 94, 130, 127	46,XY/46,XY,t(8;21)/45,X,−Y,t(8;21)
7, 10, 86, 102, 134	46,XY,t(8;21)/45,X,−Y,t(8;21)
63, 124	46,XX/46,XX,t(8;21)/45,X,−X,t(8;21)
43	46,XY/47,XY,+min(variation)/45,X,−Y,−15,del(8)(q22),del(21)(q22), tr(15)der(15;21)

mosome 9 was the autosome most frequently involved as an additional chromosomal abnormality; it was found in 17 cases, two of three of them being of the AA type. A deletion of the long arm, interstitial or terminal, but always involving the region 9q21-22, was observed in 14 cases with breakpoints scattered along the chromosome arm. Although not structural, the loss of a chromosome 9 was found in one case, and a translocation involving the short arm of the 9 in another. Chromosome 7 was involved in ten cases, with deletions between 7q21 to 7qter in five cases. In addition, translocations involving one of the bands of the 7q3 region occurred in five patients. The partner chromosomes involved in the translocations were always different. One case with translocation t(7;9)(q36;q22) was found.

Various additional translocations and deletions (Table 4) involving chromosomes 1, 3, 4, 5, 6, 8, 11, 12, 15, 18, and 19 were observed.

In patients 38 and 99 (Table 4) 7q− and 9q−, respectively, were present before the sex chromosome loss occurred. In patient 108, the Y chromosome loss was an early event as it was absent both in the single t(8;21) clone and 9q−, t(8;21) on one. Trisomy 8 may occur later during clonal evolution, as for example, in patient 117 where it was secondary to chromosome Y loss and a 7q−.

Cytogenetic results were available from 29 patients in relapse (Table 5). In ten of these cases, several chromosomal examinations were made. In first relapse, four AN patients became AA, whereas six AA patients became AN. In 15 cases, no new chromosomal abnormality was observed and the karyotype in relapse was identical to the initial one in 11 cases. In the four remaining cases, a subclone present at diagnosis had been selected as the one with sex chromosome loss in two cases (cases 1 and 124), the simplest one in patient 99, and the one bearing a 9q− in case 91. Two patients (cases 93 and 100) acquired a 9q− in relapse but one (case 99) lost it. Various chromosomes were involved in new translocations or trisomies during relapse. Bands 7p11-p12 were rearranged in two cases (cases 22 and 91). A del(11)(q23-24) was found in three cases (cases 27, 88, and 146). In case 27, which has been reported elsewhere [23], the cytologic type of the relapse was monoblastic (M5a), but in the other two the relapse was M2.

Correlation of Cytogenetics with Clinical Data

Additional autosomal abnormalities were not clustered to any age or sex group, with two exceptions: all patients with involvement of chromosome 7 were younger than 45 years, and there were more females (eight females versus six males) in patients bearing a del(9q), which contrasted with the excess of males found in the other groups of patients.

Comparison of the clinical and hematologic data of the different cytogenetic subgroups, AN versus AA, sex chromosome loss, additional chromosome abnormalities, and mosaicism did not show any significant differences.

Table 4 Autosomal abnormalities in addition to the t(8;21)

Case	Age	Type	Karyotype[a]
3	17	AA	45,X,−Y,t(8;21)/45,X,−Y,t(1;5)(q43;q12),t(8;21)
17	10	AN	46,XX,t(8;21)/46,XX,t(1;16)(p32;p12),t(8;21)
53	6	AN	45,X,−Y,t(3;15)(q29;q12),t(8;21)
19	55	AN	46,XX,dup(3)(q12→q26),t(8;21)
54	33	AA	46,XY,t(8;21)/46,XY,t(8;21),t(9;19)(p12;p13)/46,XY,t(4;8)(q13;p12),t(8;21)
6	23	AN	46,XY,t(8;21)/47,XY,+4,t(8;21)/47,XY,+var,t(8;21)
129	33	AN	46,XY,t(8;21)/46,XY,t(8;21),del(4)(q?)
143	62	AA	45,XY,−9,−12,−20,del(5)(q21q23),t(8;21),del(11)(q23),+der(12)t(12;?)(q23;?)
141	11	AA	46,XX,t(5;8;21)(q22;q22;q31)
131	14	AA	45,X,−Y,t(6;8;21)(q21;q22;q22)
4	7	AN	46,XX,del(7)(q21),t(8;21)
140	20	AA	46,XY,t(8;21)/45,X,−Y,7q−?,t(8;21)
46	25	AA	46,XY,t(7;?)(q36;?),t(8;21)
62	33	AA	45,X,−Y,−7,t(8;21),+der(7)t(7;?)(q31−q33;?)
38	36	AN	46,XY,del(7)(q32),t(8;21)/45,X,−Y,del(7)(q32),t(8;21)
25	45	AN	46,XY,del(7)(q21q31),t(8;21)
117	7	AA	45,X,−Y,del(7)(q23q36),t(8;21)/46,X,−Y,+8,del(7)(q23q36),t(8;21)
51	23	AA	46,XY,t(7;9)(q36;q22),t(8;21)
75	28	AA	44,X_i−Y,−7,−12,t(8;21),+der(7)t(7;12)(q35;q11)
139	5	AA	46,X,−X,−7,t(8;21),+der(7)t(7;13?)(q31;q13),+mar
61	10	AA	46,X,−Y,+8,t(8;21)
119	16	AN	47,XY,+8,t(8;21)
12	17	AA	47,XY,+8,t(8;21)
67	33	AA	46,X,−X,+8,t(8;21)
11	47	AN	46,X,−Y,+8,t(8;21)
133	53	AN	46,XX,t(8;21)/47,XX,+8,t(8;21)
28	57	AA	47,XY,+8,t(8;21)
42	66	AA	46,XX,t(8;21)/48,XX,+8,+15,t(8;21)
83	17	AA	47,XX,+8,del(9)(q13q33),t(8;21)
18	9	AA	47,X,−Y,+8,+13,t(8;21)
118	7	AA	45,X,−X,del(9q),t(8;21)
22	16	AA	45,X,−Y,del(9)(q13q33),t(8;21)
132	17	AA	46,XY,del(9)(q11q21),t(8;21)
45	22	AA	45,X,−X,del(9)(q22),t(8;21)
37	26	AN	45,X,−Y,del(9)(q11q?),t(8;21)
108	33	AA	45,X,−Y,t(8;21)/45,X,−Y,del(9)(q22),t(8;21)
101	36	AA	45,X,−Y,t(8;21)/45,X,−Y,del(9)(q11q21),t(8;21),/46,XY,del(9)(q11q21),t(8;21)
71	39	AA	46,XY,t(8;21)/46,XY,del(9)(q22),t(8;21)
91	49	AA	45,X,−X,t(8;21)/45,X,−X,del(9)(q11q21),t(8;21)
82	50	AA	46,XX,t(8;21)/46,XX,del(9)(q32),t(8;21)
99	50	AA	46,XX,t(8;21),del(9)(q12q31)/45,X,−X,del(9)(q12q31),t(8;21)
34	68	AA	45,X,−X,del(9q),t(8;21)
125	7	AN	46,XX,del(9q),t(8;21)/47,XX,+18,del(9q),t(8;21)
84	53	AA	46,XX,t(8;21),t(11;?)(p?;?)
95	29	AA	48,XY,t(8;21),t(12;18)(q13;q22),+mar1,+mar2
79	13	AN	45,X,−Y,del(12)(p?),t(8;21)/hyperdiploid 54→86
32	19	AA	46,XY,del(12)(p11),t(8;21)
135	19	AA	46,XX,t(8;15;21)(q22;q21;q22)
43	72	AN	47,XY,+min(variation)/45,X,−Y,−15,del(8)(q22),del(21)(q22),+r(15)der(15;21)
58	30	AN	47,XX,+15,t(8;21)
136	46	AN	45,X,−Y,t(8;19;21)(q21;p13;q21−22)

[a] The normal clone is omitted

Table 5 Karyotypes in relapse

Case	Initial karyotype	Relapse 1	Relapse 2
148	46,XX/46,XX,t(8;21)	46,XX,t(8;21)	46,XX/46,XX,t(8;21)
124	46,XX/46,XX,t(8;21)/45,X,−X,t(8;21)	46,XX/45,X,−X,t(8;21)	
98	45,X,−X,t(8;21)	45,X,−X,t(8;21)	
104	46,XX,t(8;21)	45,X,−X,t(8;21)	
103	45,X,−Y,t(8;21)	45,X,−Y,del(18)(p11),t(1;2)(p33;q34),t(8;21),var	
22	45,X,−Y,del(9)(q13q33),t(8;21)	45,X,−Y,del(9)(q13q33),t(7;16)(p11;p13),t(8;21)	
120	45,X,−Y,t(8;21)	45,X,−Y,t(8;21)	45,X,−Y,t(8;21)
15	46,XY/45,X,−Y,t(8;21)	45,X,−Y,t(8;21)	45,X,−Y,i(17q),t(8;21)
1	46,XY/46,XY,t(8;21)/45,X,−Y,t(8;21)	45,X,−Y,t(8;21)	
13	46,XY/45,X,−Y,t(8;21)	45,X,−Y,t(8;21)	
21	45,X,−Y,t(8;21)	45,X,−Y,t(8;21)	
23	45,X,−Y,t(8;21)	45,X,−Y,t(8;21)	
146	45,X,−X,t(8;21)	46,XX,t(8;21),del(11)(q23)	45,X,−X,11q−,t(8;21)
27	46,XX,t(8;21)	46,XX,t(8;21),del(10)(q24),del(11)(q23)	
88	46,XX,t(8;21)	46,XX/45,X,−X,del(11)(q14q24)/,t(8;21)	
		45,X,−X,del(2)(q32),del(11)(q14q24),t(8;21)	
91	45,X,−X,t(8;21)/45,X,−X,del(9)(q11q21),t(8;21)	46,XX/45,X,−X,9q−,t(8;21)	45,X,−X,t(8;21)/45,X,−X,inv(4),9q−, t(7;15)(p12;p11),t(8;21)
93	46,XX,t(8;21)	46,XX/46,XX,del(9)(q13q32),t(8;21)	46,XX,−10,−9,t(8;21),+mar1±mar2[a]
90	46,XX,t(8;21)	46,XX/46,XX,t(8;21)/46,XX,del(14?) (q21−q31),t(8;21)	
128	46,XX/46,XX,t(8;21)	46,XX/46,XX,t(8;21)/46,XX,t(8;21),t(3;11) (q21−q23;p14),t(13;17)(cen;cen)/ idem,−17/47,XX/46,XX,t(3;11),t(8;21), t(13;17)+21/1p+,del(6q)	
145	46,XY,t(8;21)	46,XY,t(8;21)	
97	45,X,−Y,t(8;21)	46,XY/45,X,−Y,t(8;21)	
94	46,XY/46,XY,t(8;21)/45,X,−Y,t(8;21)	46,XY/46,X,−Y,+8,t(8;21)	
100	46,XY/46,XY,t(8;21)	46,XY/46,XY,del(9)(q12q31)	
147	46,XY,t(8;21)	46,XY/46,XY,t(8;21)	46,XY/46,XY,t(8;21)
92	46,XY,t(8;21)/46,XY,−22,t(8;21),+mar(1or2)	nd	46,XY/46,XY,t(8;21)
127	46,XY/46,XY,t(8;21)/45,X,−Y,t(8;21)	46,XY/46,XY,t(8;21)/45,X,−Y,t(8;21)	
119	46,XY/47,XY,+8,t(8;21)	46,XY/49,XY,+8,+18,+22,t(8;21)	
95	48,XY,t(8;21),t(12;18)(q13;q22),+mar1,+mar2	48,XY,−8,+der(8)t(1;8)(q32;q24),t(8;21),t(12;18) (q13;q22),+M1,+M2	
99	46,XX,del(9)(q12q31),t(8;21)/45,X,−X,9q−,t(8;21)	46,XX,t(8;21)	

[a] clone observed in third relapse.

Prognosis

Chemotherapy was minimal in four cases, and no treatment was given in two cases. In the remaining 141 cases, the treatment was protocolar chemotherapy with at least one anthracycline. It was followed by a bone marrow allogenic transplantation in complete remission in 17 cases or by an autograft in two patients.

Among the 141 cases consistently treated, 128 achieved complete remission, seven died during induction, and six were still leukemic. The remission rate thus was 90.7%. It was similar in males and females, children and adults. Two of the patients who died during induction had a 7q abnormality (cases 25 and 135) and a third patient had a variant translocation (case 3).

For this sample, the median survival was 17.5 months from diagnosis; patients had a 24% probability of 5 year survival, while the median disease-free duration was 10 months. Because of the high complete remission rate, the survival of patients having complete remission was not different. The median survival time of patients treated by chemotherapy was 16 months versus 18 months for patients receiving a bone marrow graft, but survival curves joined quickly and the log rank was not significant. Children had a median survival of 24 months from diagnosis and a 48.6% probability for a 5-year survival, which is to be compared to 16 months and 23% for the adults. Median disease-free survival was 20 months for children and 10 months for adults. However, the two groups were not statistically different.

Median survival of the AN versus AA group was virtually the same, 18 and 17 months. Although the survival curve of AA was slightly inferior to AN, the difference was not significant. Loss of a sex chromosome was not associated with a worse prognosis even when males and females were subdivided. The presence of additional autosomal abnormalities did not alter the prognosis. The same result was obtained taking into account only structural rearrangements. No statistically significant correlation between sex, age, and loss of sex chromosome and prognosis was found. A white cell count higher than 10,000/ml was not associated with a poorer prognosis compared to patients with no hyperleucocytosis. The platelet count was not a discriminating factor for prognosis.

DISCUSSION

The AML presenting the t(8;21) constitute a homogeneous entity, highly correlated with an M2 phenotype [3, 9–12]. For this reason, the MIC working group proposed to delineate this group on ANLL as an entity named M2/t(8;21) [8]. The specificity of the disease was confirmed by our study as there were only nine cases of M1 and two cases of M4. No correlation was found between the presence of additional chromosome abnormalities and an unusual cytologic subtype. That this type of leukemia occurs in younger age groups was also confirmed in this study, because 80% of the cases were younger than 50 years. The mean age of 30 years was within the same decade as the one reported previously [3, 9, 13, 24–29]. As previously described, the sex ratio was skewed in this leukemia, with a value of 1.5. We found a normal sex ratio in the children, but the adult population showed a strong male prevalence (72%).

The present series confirms previous observations [5] on the usefulness of bone marrow short-term cultures to detect cells with the t(8;21).

Complex variant translocations involving 8q22, 21q22, and another chromosome had a frequency of 3.4%. No particular variant type emerged from previous studies or from the present one [22, 30–34]. In the MIC report on AML [8], the overall frequency of variants was estimated to be 4%. A high frequency of complex translocations has been reported in Japan (four out of 34) [33], but at the FIWCL [9] as well as in series

from other laboratories, no cases were reported [26, 35]. The presence of additional chromosomal abnormalities appears to be a very characteristic feature of this leukemia [2, 3, 12]; in our series it was found in 75% of the cases. Loss of a sex chromosome was the most frequent associated abnormality (72%). Loss of a chromosome X in females was less frequent than loss of a Y chromosome in males. The occurrence of additional other abnormalities, however, was more frequent in females (50%) than in males (18%).

The other recurrent numerical abnormality was trisomy of the apparently normal chromosome 8, which occurred, as part of the main clone or in a subclone, in 7.5% of the patients. Therefore, it did not differ from other ANLLs in this respect, which is contrary to other reports [14].

The most frequent structural additional rearrangement of an autosome was deletion of the long arm of chromosome 9, which occurred in nearly 10% of the cases, with chromosome 9 being involved overall in 11.5% of patients. This abnormality and its restriction to t(8;21) leukemia has been widely recognized [9, 15, for review]. The slight excess of females found with chromosome 9 abnormalities is to be mentioned because of the particular sex distribution of t(8;21) leukemia.

Another recurrent autosome rearrangement involved chromosome 7q with a frequency of 7%. This abnormality has not been recognized as a characteristic pattern of this leukemia, although it has been described previously [13, 26, 28].

None of these rearrangements were mutually exclusive as patients presented several of these abnormalities. For example, case 83 had trisomy 8 as well as 9q−. The sequence of appearance of these abnormalities apparently does not follow any rule as different patterns of abnormalities could be observed.

In relapse, we found three cases of acquired 11q23-24 rearrangement as the only recurrent abnormality. No specific cellular phenotype characterized these three cases.

A high complete remission (CR) rate of 90.7% was observed. There was no obvious difference between children and adults or between males and females. Remission rate was similar in AA and AN groups. It was similar to the CR rates observed in smaller series reported previously [13, 26, 28, 36]. The median survival of patients who received chemotherapy was 17.5 months (29% for the 5-year survival probability) and was about the same for the patients achieving a complete remission. These values were comparable to those reported elsewhere [13, 36]. It was longer than the 13–14 months found in the FIWCL [9], but the duration of complete remission of 10 months was the same as in the present series.

No difference could be found for a number of other parameters such as male versus female or chemotherapy only versus bone marrow graft. In contrast with other studies [36], we did not find any correlation between either the white blood cell or platelet counts and prognosis. Correlation with karyotype failed to isolate a subgroup with a higher risk. In particular, we did not find any significant difference in prognosis between the AN and AA groups, groups with a sex chromosome loss, or groups with additional chromosome abnormalities, which is similar to the conclusion of O'Brien et al. [36]. The only subdivision giving a different (although not statistically significant) median survival was the age group under 16 versus over 16. Remarkably, children had a tendency to have a better prognosis (24-months' median survival) than adults (16-months' median survival). The same observation was made with respect to a 5-year survival probability, which was 23% in adults and 48.6% in children. The difference between the two groups was also found when the disease-free survival period was considered, with a median of 20 months for children versus 10 months for adults. These results are similar to those reported by Prigogina et al. [28], which contained mainly young patients and also gave a similar survival duration for the t(8;21), contrary to a recent report on ANLL in children [37].

The fact that t(8;21) ANLL patients exhibit a very high complete remission rate could at first glance lead to the speculation that they may have a better survival than others. However, the 17-month median survival duration calculated from this sample is very similar to that reported in recently published series when a comparison is made between patients in complete remission [9, 11, 13, 29, 36]. Then the prognosis of t(8;21) is not substantially different from other ANLL cases with chromosome abnormalities and is worse than that of M4 with eosinophilia [9, 11, 13] as well as that of leukemia with a t(15;17) [9, 13].

These results could mean that in a leukemia characterized by a precise chromosome abnormality and a defined prognosis profile, the other survival factors such as age could be of importance. In order to investigate these parameters, it will be necessary to study large cohorts of patients, which is possible only in cooperative multicenter studies.

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