Published in final edited form as:

J Clin Pathol. 2015 March ; 68(3): 236–240. doi:10.1136/jclinpath-2014-202697.

Clinicopathological analysis of near-tetraploidy/tetraploidy acute myeloid leukaemia

Changlee S Pang¹, Mark J Pettenati², and Timothy S Pardee³

¹Department of Pathology, Wake Forest University School of Medicine, Medical Center Boulevard, Winston Salem, North Carolina, USA

²Department of Genetics, Wake Forest University School of Medicine, Medical Center Boulevard, Winston Salem, North Carolina, USA

³Department of Hematology/Oncology, Wake Forest University School of Medicine, Medical Center Boulevard, Winston Salem, North Carolina, USA

Abstract

Aims—Near-tetraploidy/tetraploidy (NT/T) is a rare cytogenetic alteration in acute myeloid leukaemia (AML). NT/T-AML is categorised as complex cytogenetics and therefore, presumed to have an unfavourable prognosis. Our aim is to further characterise the clinical, morphological, cytogenetic and prognostic features of NT/T-AML.

Methods—We searched our cytogenetic laboratory database from 1991 to 2012 to reveal 13 cases of NT/T-AML. Each case was evaluated with regard to its demographics, morphology, immunophenotype and prognosis. Specific morphological features included blast size, irregularity of nuclear contours, cytoplasmic vacuoles, and presence and lineage of dysplasia.

Results—Eleven men and two women had a median age of 68 years. Blasts were predominately large (11/13). Eight of 13 patients had AML with myelodysplasia-related changes. Sixty-nine per cent of patients achieved complete remission (CR). Median overall survival (OS) was 8.6 months. CR rate and median OS in cases with ≥5 cytogenetic abnormalities were 71% and 6 months, compared with 67% and 18.1 months in cases with <5 abnormalities.

Conclusions—NT/T-AML occurs in older males, exhibits large blast size and is associated with myelodysplasia. Unlike previously reported data, our study reveals an overall better prognosis in this older population with NT/T-AML than was expected for a complex karyotype AML. Cytogenetic complexity independent of ploidy status did not greatly affect the high CR rates, but did appear to be a better estimation of prognostic risk in terms of median OS.

Correspondence to: Dr Changlee S Pang, Department of Pathology, Wake Forest University Baptist Medical Center, Medical Center Boulevard, Winston Salem, NC 27157, USA; ; Email: cpang@wakehealth.edu

Handling editor Cheok Soon Lee

Contributors The concept of this study was created by CSP. All authors contributed to the planning, conducting and reporting of the research, writing and the final approval of the manuscript.

Competing interests None.

Ethics approval Institutional Review Board at Wake Forest University School of Medicine.

Provenance and peer review Not commissioned; externally peer reviewed.

INTRODUCTION

Near-tetraploidy/tetraploidy (NT/T) is a rare cytogenetic alteration in acute myeloid leukaemia (AML). AML with specific chromosomal alterations often have associated clinical, morphological, immunophenotypic or prognostic features.¹ Findings frequently cited in NT/T-AML are of an older age at diagnosis, with male predominance and large blast size. Other features, such as presence of dysplasia, expression of CD34, degree of differentiation and association with erythrophagocytosis have been variably reported. The importance of cytogenetics in the prognosis of AML is well established.² NT/T-AML is categorised as complex cytogenetics and therefore, presumed to have an unfavourable prognosis.³ However, the prognostic implication of NT/T in AML is difficult to accurately characterise owing to the rarity of cases and the presence of additional chromosomal alterations which incur their own prognostic value. To better characterise this entity, we reviewed 13 cases of NT/T-AML by assessing the clinical, morphological, cytogenetic and prognostic features.

MATERIALS AND METHODS

Case selection

Thirteen cases of NT/T-AML were identified in the Wake Forest School of Medicine Cytogenetic Laboratory database, including children and adults, from 1991 to 2012. Medical records for each case were reviewed after Institutional Review Board approval. Mixed phenotype acute leukaemias (acute leukaemia of ambiguous lineage) were excluded.

Clinical data

Available clinical data for each case were reviewed, including age, gender, presentation and treatment. Complete remission (CR) was defined according to the National Cancer Institute criteria: <5% blasts in bone marrow aspirates, granulocyte count $>1 \times 10^9/L$ and platelet count $>100 \times 10^9/L$.⁴ Refractory disease included patients with treatment failure to achieve a CR following induction therapy. Overall survival (OS) was calculated from the date of NT/T-AML diagnosis to date of death.

Morphological and phenotypic features

Bone marrow aspirates and core biopsies were reviewed for each case. The cases were classified according to 2008 WHO criteria, as well as the French-American-British (FAB) classification. Each case was examined for specific morphological features including blast size, irregularity of nuclear contours, presence of cytoplasmic vacuoles, cytoplasmic blebbing and Auer rods. The presence and lineage of dysplasia were assessed. Available immunophenotype by flow cytometry and/or immunohistochemistry was reviewed in each case.

Cytogenetic studies

Conventional karyotyping using G-banded metaphase cells was performed in all cases. Detected abnormalities were described according to the International System for Human Cytogenetic Nomenclature. NT/T was defined as 82–100 chromosomes in at least 10% of

cells. Complex karyotype (CK) was defined as ≥ 5 distinct cytogenetic abnormalities, as outlined by the Medical Research Council for AML in older populations.

RESULTS

Clinical findings

Table 1 summarises the clinical features of 13 cases of NT/T-AML. Patients' age ranged from 43–76 years, with a median age of 68 years. Eleven of 13 (85%) cases were male. All patients were Caucasian. Ten patients presented with signs or symptoms of bone marrow failure, such as fatigue, fever and cytopenia. The remaining two patients presented with skin lesions, subsequently diagnosed as myeloid sarcoma. Myeloid sarcoma was the presenting sign of relapse for one patient. Five patients had a prior history of myelodysplastic syndrome (MDS) with three patients diagnosed at an outside hospital and the diagnoses confirmed by reviewing the slides at our institution. Therapy-related AML was not observed in this study.

Morphology and phenotype

The initial NT/T-AML diagnosis and corresponding morphological features are presented in table 2. Eight cases (62%) were diagnosed as AML with myelodysplasia-related changes (AML-MRC). Five of eight AML-MRC cases had a documented history of prior myelodysplasia, while the remaining three presented with sufficient dysplasia at the time of diagnosis. AML cases without dysplasia were classified as AML, NOS with minimal differentiation (n=1), AML with maturation (n=2), acute myelomonocytic leukaemia (n=1) and AML with t(8;21; n=1). According to FAB classification, M2 was the most frequent group (9/13 cases). There was one case each of FAB types M0, M1, M4 and M6.

To distinguish the size of blasts, the diameter of normocytic red blood cells (RBC) was used. Blasts >4 RBC were observed in 12 cases comprising 10–70% (average of 31%) of total blasts. Blasts of sizes 2–4 RBC were present in all 13 cases and these accounted for 39% on average, ranging 20–60% of total blasts. In cases 4 and 8 with the youngest patients (43 and 45 years old, respectively), small blasts <2 RBC comprised the majority of the blasts. Blast morphology was predominately large in 11 cases. Several cases demonstrated excessively large size or bizarre morphology (figure 1). Vacuoles were present in eight cases (62%; figures 1 and 2). Atypical intracytoplasmic vacuole-like large inclusion with a slightly pink hue was identified in case 3 (figure 2). Seven cases (54%) had irregular nuclear contours, including clefts or indentations. Cytoplasmic blebs were noted in 6 of 13 cases. Auer rods were identified in one case with t(8;21). Dysplasia was evident at the time of diagnosis in eight cases (62%). Dyserythropoiesis was present in seven cases (54%), with one case demonstrating ring sideroblasts. Five cases (38%) had dysmegakaryopoiesis and four cases (31%) had dysgranulopoiesis.

Phenotypically the leukaemic blasts frequently expressed CD13 and CD34 (90% and 83%, respectively) followed by HLA-DR (73%) and CD33 (67%). Monocytic and erythroid differentiation was observed in case 3 and case 5, respectively. Expression of dim CD7 was detected in a subset of blast population in case 6.

Cytogenetics

Karyotypes for all 13 patients with NT/T-AML at the time of AML diagnosis are listed in table 3. Multiple cytogenetic abnormalities were frequent, with only two cases exhibiting NT/T as the sole abnormality (figure 3). Nine cases demonstrated a coexisting normal diploid cell line. Numerical alterations were seen in nine cases. Structural alterations were present in four cases. The most common abnormalities were seen in 4/13 cases, including +X, -7, -5/5q and +19. Cases with -5/5q abnormalities correlated with morphological evidence of dysplasia. Cases with -7 did not have dysplasia. Only the case with t(8;21) demonstrated an abnormality in the NT/T cell line and diploid cell line. Clonal evolution was detected at relapse in three cases, all which presented with myeloid sarcomas.

Treatment, response and clinical outcome

Treatment, response and outcome data are provided in table 1. All patients received induction chemotherapy. Specific regimens were not clearly documented in four patients. Patients with documented treatment received standard induction regimens with cytarabine and anthracyclines with/without etoposide, except for one patient receiving a high dose of cytarabine and asparaginase. One patient with t(8;21) received dasatinib in addition to standard therapy. Reinduction and subsequent therapy was variable. CR was achieved in 9 of 13 patients (69%). Two additional patients achieved leukaemia-free states, but failed to recover their peripheral blood counts to meet criteria for CR. Median OS for all patients with NT/T-AML was 8.6 months. One patient had an OS of 58 months. This patient was female, had no history of MDS and received interleukin (IL)-2 remission maintenance therapy. Two younger patients received allogeneic stem cell transplants, one of whom died in remission. Exclusion of the two younger patients (43 and 45 years) yielded a CR rate of 64% and median OS of 8.6 months. Data for subgroups of NT/T-AML are listed in table 4. The CR rate and median OS for eight patients with MDS at or prior to diagnosis was 67% and 8.5 months, compared with 75% and 8.6 months for the five patients without MDS. Seven patients with CK independent of ploidy status had a CR rate of 71% and median OS of 6 months. Six patients with non-CK independent of ploidy status had a CR rate of 67% and median OS of 18.1 months. Of these six non-CK cases, four had myelodysplasia, two had tetraploidy as the sole anomaly, one had t(8;21) and two had cytogenetic abnormalities generally considered to be unfavourable (-5/del(5q), -7/del(7q)).

DISCUSSION

Our study of 13 patients with NT/T-AML represents the largest single institution case series of NT/T-AML to date. The patients were predominately Caucasian men and had a median age of 68 years. This is similar to the majority of reported NT/T-AML cases which show a similar male predominance and a median age of 50–70 years.³⁵⁶ The major exception to this study is a series of NT/T-AML associated with mediastinal myeloid sarcoma, all of which were younger women.⁷ Only one of our myeloid sarcoma cases presented in the mediastinum. All three myeloid sarcoma cases were associated with clonal evolution, a relationship not previously documented.

Blast morphology is the most frequently cited association with NT/T-AML. The large blast size in NT/T-AML is proposed to reflect the increased DNA content of the cells. Analysis of blast size in NT/T-AML has found these blasts are 52% larger than non-NT/T-AML blasts. Kwong and Wong⁸ emphasised that the large and bizarre blasts in AML provide a morphological clue to the underlying karyotype.⁵⁹ Supporting this observation, 85% of our cases demonstrated predominately large to extremely large blasts. Irregular nuclear contours, cytoplasmic vacuoles and cytoplasmic blebbing were observed in many of our cases and may be additional morphological clues when combined with large blast size.

The majority of published NT/T-AML cases predate the 2008 WHO classification. As in our study, a wide range of FAB classifications are represented in the literature; however, M2 appeared to be most common.³⁵⁻⁷ According to the 2008 WHO classification, 85% of our cases had preceding MDSs or myelodysplastic features at the time of diagnosis sufficient to be classified as AML-MRC. Dyserythropoiesis was the most common finding. A multi-institutional series documented 25 cases of NT/T-AML with dysplasia at diagnosis. Eighty-five per cent of those cases exhibited dysplasia in at least the erythroid lineage.¹⁰ AML-MRC is known to have lower CR rates and poorer prognosis.¹ Our series showed only a slightly lower CR rate for AML-MRC cases (66%) compared with non-AML-MRC cases (75%). However, no significant difference in median OS was observed between cases with (8.5 months) and without (8.6 months) myelodysplasia. Thus, it appears that myelodysplasia is common in NT/T-AML, but the prognostic relevance is unclear.

Cytogenetic abnormalities occur frequently in AML and are one of the most important prognostic factors available.² NT/T status is often presumed to belong to the category of complex cytogenetics and has, therefore, been associated with a poor prognosis.³ Because many NT/T-AML cases often have multiple cytogenetic abnormalities, this generalisation may not be unreasonable. With only individual reports and small series of NT/T-AML, the CR and OS data have been variable but generally regarded as poor.³⁷¹⁰¹¹ Our data challenge the perceived poor prognosis of NT/T-AML and specifically identify a subgroup of NT/T-AML with favourable and unfavourable OS. However, given the small number of patients reported here, definitive conclusions on the prognosis of these patients must await larger cohorts.

Within the past several years, the prognostic role of cytogenetics has been an area of much interest leading to redefining of cytogenetic risk groups in older populations and further, characterisation of high-risk or unfavourable cytogenetic abnormalities. From the prognostic point of view, our study revealed somewhat different results from the previously reported data. When using cytogenetic risk groups, recently established for older AML patient populations (table 5), our cases had a better CR rate (69%) and median OS (8.6 months) than would be predicted based on CK (CR rates: 19–26%, median OS: 3.8–5.1 months²). While individual case reports point to an unfavourable prognosis for NT/T-AML, our data more closely reflect an intermediate cytogenetic risk group (CR rates: 53–59%, median OS: 9.2–12.5 months).²¹² Data from Bene *et al*'s series further support our findings. Their patients with NT/T-AML treated with induction chemotherapy had a CR rate of 55% and a median OS of 8.8 months (table 4).

We identified two distinct subgroups of NT/T-AML based on the number of cytogenetic abnormalities, similar to the complex and non-CK categories of diploid AML. When viewed independently of NT/T status, CK and non-CK had high CR rates (67–71%), between the intermediate and favourable cytogenetic risk range (53–59% and 72–80%, respectively). However, median OS of CK cases (6 months) was dramatically lower than in non-CK cases (18.1 months). Thus, CK regardless of ploidy status conferred an unfavourable risk in terms of median OS, while non-CK cases were closest to the favourable risk category for median OS. These data recapitulate the division of CK and non-CK based on the number of chromosomal aberrations seen in diploid AML. Data from Bene *et al*'s study revealed that patients with CK NT/T-AML who received induction chemotherapy had a CR rate of 38% and median OS of 5.3 months. Non-CK cases had a CR rate of 57% and median OS of 12.2 months. Therefore, their data suggest an unfavourable cytogenetic risk for CK cases and an intermediate cytogenetic risk for non-CK cases. Two non-CK cases were still alive at the time of study. While our findings suggest NT/T status confers a slightly better CR rate, the lower CR rates from Bene's study may be due to the variation in induction regimens used by multiple institutions. A recent case report by Lemež *et al*¹³ describes a patient with NT/T-AML with an exceptionally long survival time of 80 months. This patient had a non-CK of 92~95<4n>,XXYY,inc[19]/46,XY[5]. Of note, this patient received IL-2 maintenance therapy. Although larger studies revealed no benefit to IL-2 maintenance therapy in AML, it is interesting that patient 9 in our study also received IL-2 maintenance therapy and had the longest survival time (58.2 months).

Our study demonstrates that NT/T-AML occurs in a predominately older male population, exhibits large blast size and is frequently associated with myelodysplasia. In this older population, NT/T-AML has an overall better prognosis than would be expected for a CK AML. Cytogenetic complexity independent of ploidy status did not greatly affect the high CR rates, but did appear to be a better estimation of prognostic risk in terms of median OS.

References

1. Swerdlow, S.; Campo, E.; Lee, H., et al. WHO classification of tumours of haematopoietic and lymphoid tissues. 4th. Lyon, France: IARC Press; 2008.
2. Grimwade D, Walker H, Harrison G, et al. The predictive value of hierarchical cytogenetic classification in older adults with AML: analysis of 1605 patients entered into the MRC AML11 trial. *Blood*. 2001; 98:1312–20. [PubMed: 11520776]
3. Iyer RV, Sait SN, Matsui S, et al. Massive hyperdiploidy and tetraploidy in acute myelocytic leukemia and myelodysplastic syndrome. *Cancer Genet Cytogenet*. 2004; 148:29–34. [PubMed: 14697638]
4. Cheson BD, Bennett JM, Kopecky KJ, et al. Revised recommendations of the International Working Group for Diagnosis, Standardization of Response Criteria, Treatment Outcomes, and Reporting Standards for Therapeutic Trials in Acute Myeloid Leukemia. *J Clin Oncol*. 2003; 21:4642–9. [PubMed: 14673054]
5. Clarke MR, Lynch EF, Contis LC, et al. Near-tetraploidy in adult acute myelogenous leukemia. *Cancer Genet Cytogenet*. 1996; 86:107–15. [PubMed: 8603334]
6. Espinet B, Solé F, Woessner S, et al. Two new cases of near-tetraploidy in adult acute myeloid leukemia. *Cancer Genet Cytogenet*. 1998; 102:131–4. [PubMed: 9546065]
7. Au WY, Ma SK, Chan AC, et al. Near tetraploidy in three cases of acute myeloid leukemia associated with mediastinal granulocytic sarcoma. *Cancer Genet Cytogenet*. 1998; 102:50–3. [PubMed: 9530340]

8. Kwong YL, Wong KF. Hyperdiploid acute myeloid leukemia: relationship between blast size and karyotype demonstrated by fluorescence in situ hybridization. *Cancer Genet Cytogenet.* 1995; 83:1–4. [PubMed: 7656196]
9. Zhang JH, Zheng YC, Wang YX, et al. Enlarged and prominent nucleus may be indicative of tetraploidy: a laboratory study of a rare near-tetraploidy in a child patient with acute myelogenous leukemia AML-M4. *J Pediatr Hematol Oncol.* 2010; 32:19–21. [PubMed: 19816206]
10. Béné MC, Castoldi G, Derolf A, et al. Near-tetraploid acute myeloid leukemias: an EGIL retrospective study of 25 cases. *Leukemia.* 2006; 20:725–8. [PubMed: 16437146]
11. Lemež P, Michalová K, Zemonová Z, et al. Three cases of near-tetraploid acute myeloid leukemias originating in pluripotent myeloid progenitors. *Leuk Res.* 1998; 22:581–8. [PubMed: 9680107]
12. Fröhling S, Schlenk RF, Kayser S, et al. Cytogenetics and age are major determinants of outcome in intensively treated acute myeloid leukemia patients older than 60 years: results from AMLSG trial AML HD98-B. *Blood.* 2006; 108:3280–8. [PubMed: 16840728]
13. Lemež P, Klamová H, Zemanová Z, et al. Unusually long survival of a 67-year-old patient with near-tetraploid acute myeloid leukemia M0 without erythroblastic and megakaryocytic dysplasia. *Acta Haematol.* 2011; 126:129–34. [PubMed: 21701158]

Take home messages

- ▶ Near-tetraploidy/tetraploidy acute myeloid leukaemia (NT/T-AML) occurs in a predominately older male population, exhibits large blast size and is frequently associated with myelodysplasia.
- ▶ In this older population, NT/T-AML has an overall better prognosis than expected for a complex karyotype AML.
- ▶ Cytogenetic complexity independent of ploidy status did not greatly affect the high complete remission rates, but did appear to be a better estimation of prognostic risk in terms of median overall survival.

Figure 1. Atypical large blasts with irregular nuclear outlines and frequent cytoplasmic vacuoles/ vacuole-like large inclusion.

Figure 2.
Bizarre morphology of leukaemic blast with prominent cytoplasmic vacuoles and large vacuole-like inclusion.

Figure 3.
Representative near-tetraploid/tetraploid acute myeloid leukaemia karyotype of case 3.

Table 1

Clinicopathological data

Case	Age	Sex	Presentation	Induction treatment	Treatment response	Subsequent treatment	Death	OS (months)
1	58	M	BMF	I-A+C+E	RD		TRD-sepsis	0.9
2	61	M	BMF	I-ND, RI-HAM×2	RD		AML	2.8
3	68	M	MS	I-A+C+E, RI-MEC×2	RD		AML	4.1
4	43	M	BMF	I-A+C+E	CR	C-HiDAC, Allo SCT	TRD-sepsis*	3.9
5	70	M	BMF	I-A+C, RI-A+C	CR	C-HiDAC, RI-A+C+E, RI-HAM	Relapse	6
6	72	M	BMF	I-ND	CR	RI-cytosan, etoposide	Relapse	7.4
7	76	M	BMF	I-ND	CR	RI-mylotarg	TRD-sepsis	8.6
8	45	M	BMF/MS	I-ND	CR	Allo SCT	Relapse MS	28
9	66	F	BMF	I-A+C+E, RI-A+C+E	CR	C-A+C+E, M-IL2, RI-HAM, C-HAM	TRD-C diff*	58.2
10	68	M	MS	I-A+C, RI-HAM, RI-cytosan, etoposide	RD		AML	9.6
11	66	M	BMF	I-A+C+E, RI-A+C+E	CR	ND	Relapse	24.6
12	69	M	BMF	I-HiDAC+asparaginase	CR	RI-A+C+E, RI-A+C+E	TRD-sepsis	40
13	70	F	BMF	I-A+C+dasatinib	CR	C-HiDAC +dasatinib RI-HiDAC, vosaroxin	Relapse	11.6

* Indicates patient died in CR.

A, anthracycline; AML, acute myeloid leukaemia; BMF, bone marrow failure; C diff, *Clostridium difficile* colitis; C, consolidation; C, cytarabine; CR, complete remission; E, etoposide; HAM, high-dose cytarabine+mitoxantrone; HiDAC, high-dose cytarabine; I, induction; M, maintenance; MEC, mitoxantrone+etoposide+cytarabine; MS, myeloid sarcoma; ND, not documented; OS, overall survival; RD, refractory disease; RI, reinduction; TRD, treatment-related death.

Table 2

Diagnosis and morphology data

Case	WHO diagnosis	FAB diagnosis	Evidence of dysplasia	Type of dysplasia	Blast morphology
1	AML-MRC	M2	At diagnosis	E, G, M	L, V
2	AML-MRC	M2	RAEB	E, G, M	L, I
3	Acute myelomonocytic leukaemia	M4			L, I, V, B
4	AML with minimal differentiation	M0			
5	AML-MRC	M6	At diagnosis	E (RS), G, M	L, V
6	AML-MRC	M2	MDS	E	L
7	AML with maturation	M2			L, V, B
8	AML-MRC	M2	At diagnosis	E, G, M	
9	AML with maturation	M2			L, I, V, B
10	AML-MRC	M2	RAEB	M	L, I, V, B
11	AML-MRC	M1	RARS	E	L, I, B
12	AML-MRC	M2	RAEB	E	L, I, V, B
13	AML with t(8;21)	M2			L, I, V, A

A, Auer rods; AML-MRC, acute myeloid leukaemia with myelodysplasia-related changes; B, cytoplasmic blebbing; E, erythroid; FAB, French-American-British; G, granulocytic; I, irregular nuclear contours; L, large size; M, megakaryocytic; MDS, myelodysplastic syndrome; RAEB, refractory anaemia with ringed sideroblasts; RARS, refractory anaemia with ringed sideroblasts; V, cytoplasmic vacuoles.

Table 3

Karyotypes

Case	Karyotype
1	92,XXYY,del(5)(q13q35)×2,der(12)t(12;14)(p11.2;q11.2)×2,der(17)t(15;17)(q15;p11.2)×2,+mar,+dms[20]
2	91,XXYY,-2,-5,+der(2)t(2;5)(q11.2;p12)[6]/46,XY[13]
3	92<4n>.XY,+X,+Y,+X,-7,+8,+8,-9,-10,-11,-12,-15,+19,+20[14]/46,XY[5]
4	89~93,XXYY,-7,+19+22,+mar1,+mar2[16]/46,XY[18]
5	86<4n>.XY,+Y,+Y,-3,del(5)(q13q31),+6,+6,-12,-17,-17,del(20)(q11)×2[20]
6	82~88,XY,+X,+1,+1,+2,+3,+3,+4,+4,+5,+5,+6,+7,+8,+8,+9,+10,+10,+11,+11,+12,+12,+13,+13,+14,+14,+15,+15,+16,+17,+17,+18,+18,+19,+19,+20,+20,+21,+21,+22,+22,+mar[18]/46,XY[6]
7	88-93,X,+X,-Y,-6,-7,-17,-21,-21,+mar4[14]/46,XY[6]
8	88,XY,+X,+Y,+iso(Xq),+iso(Xq),+1,+iso(1q),+dup(2)(q11q21),+dup(2)(q11q21),+3,+3,+del(3)(q21),+4,+4,+del(5)(q13q35),+del(5)(q13q35),+7,+7,-8,+8,+10,+10,+11,+11,+13,+13,+14,+14,+16,+16,+18,+18,+19,+19,+20,+20,+21,+21,+der(21)t(21;?)(q22;?),+der(22)t(22;?)(q12;?),+der(22)t(22;?)(q12;?),+mar1,+mar1,+mar2,+mar2 [20]/46,XY [10]
9	89,XXXX,-7,-8,-12[17]/46,XX[8]
10	92,XXYY[6]/46,XY[14]
11	90,XXYY,-10,-20[3]/92,XXYY[14]
12	92-182,XXYY[8]/46,XY[12]
13	92<4n>.XX,t(8;21)(q22;q22)[11]/46,XX,t(8;21)(q22;q22)[6]

Table 4

Response and outcome data for subgroups of NT/T-AML

NT/T-AML subgroups	CR rate (%)	Median OS (months)
Current study		
NT/T-AML overall	69	8.6
NT/T-AML without MDS	75	8.6
NT/T-AML with MDS	67	8.5
NT/T-AML without CK	67	18.1
NT/T-AML with CK	71	6
Bene <i>et al</i>		
NT/T-AML overall	55	8.8
NT/T-AML without CK	57	12.2
NT/T-AML with CK	38	5.3

AML, acute myeloid leukaemia; CK, complex karyotype; CR, complete remission; MDS, myelodysplastic syndrome; NT/T, near-tetraploidy/tetraploidy; OS, overall survival.

Table 5Cytogenetic risk groups for older patients with AML²

Cytogenetic risk group	CR rate (%)	Median OS (months)
Favourable	72–80	18.6–26.4
Intermediate	53–59	9.2–12.5
Unfavourable	19–26	3.8–5.1

AML, acute myeloid leukaemia; CR, complete remission; OS, overall survival.