Dynamic Cytogenetic Clonal Evolution During CML Transformation to AML: A Case Report with Diagnostic help of “Karyoview” and artificial intelligence “Chromomind”

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Background: Transformation of CML into AML blast phase is driven by cytogenetic clonal evolution and is associated with an unfavorable prognosis. Acquisition of additional chromosomal abnormalities beyond the Philadelphia chromosome reflects genomic instability and disease progression. Comprehensive cytogenetic and molecular analyses is essential for monitoring the disease and karyotyping is now becoming more precise for identifying emerging clones using KaryoviewÒ -an ideogram generator for chromosomal rearrangements- with integrated ChromomindÒ AI.

Purpose: To describe the sequential cytogenetic evolution of CML patient transforming into AML and to demonstrate the complementary role of cytogenetic, molecular, and chimerism analyses in monitoring dynamic clonal changes throughout the disease course.

Methods: Serial conventional G-banded karyotyping, FISH, RT-PCR, and next-generation sequencing were run for molecular and cytogenetic analyses. The latter was run with KaryoviewÒ and ChromomindÒ AI Results Initial cytogenetic analysis at AML transformation demonstrated 47,XX,t(1;21)(p36;q22),t(9;22)(q34;q11.2),+8 with BCR::ABL1 p210 positivity. NPM1, FLT3, and CEBPA mutation analyses were negative. Although recurrent AML-associated rearrangements including t(8;21), t(15;17), and inv(16)/t(16;16) were absent, FISH revealed trisomy 8 and chromosome 21 rearrangement signals. Subsequent analyses documented striking cytogenetic evolution with disappearance of the initial clone and emergence of i(17)(q10), followed by inv(3)(q21q26),-9,+der(9)t(9;22),i(17)(q10). Additional independent clone of t(7;15)(p14;q21),dic(9;12)(q11-13;p11-12),+22 identified and confirmed with Karyoview, accompanied by further subclonal abnormalities. Serial donor chimerism analyses demonstrated progressive donor engraftment despite transient molecular persistence of BCR::ABL1 and ultimate complete remission achieved.

Conclusions: This case illustrates rapid and complex cytogenetic clonal evolution during CML transformation to AML, characterized by sequential acquisition and replacement of multiple cytogenetic clones. The coexistence of rare abnormalities including t(1;21), inv(3), i(17q), dic(9;12), and additional derivative chromosomes highlights the genomic instability underlying blast transformation. Comprehensive evaluation by Karyoview- ChromomindÒAI integrated conventional cytogenetics, FISH, molecular testing, and donor chimerism analysis proved essential for identifying evolving clones, monitoring post-transplant disease dynamics, and confirming molecular remission.