Atlas of Genetics and Cytogenetics in Oncology and Haematology

OPEN ACCESS JOURNAL AT INIST-CNRS

Leukaemia Section
Mini Review

t(7;9)(q34;q32)

Jacques Boyer

Laboratoire d'Hématologie, CH du MANS, France (JB)

Published in Atlas Database: November 2002

Online updated version : http://AtlasGeneticsOncology.org/Anomalies/t0709q34q32ID1056.html
DOI: 10.4267/2042/37935

Clinics and pathology

Disease

Specifically associated with T-cell acute lymphoblastic leukemia (T-ALL).

Epidemiology

The t(7;9)(q34;q32) is present in two cases of a serie of 5 patients with 7q34 involvment.

Clinics

Children with large mediastinal mass.

Cytology

The hematological feature of the T-ALL with rearrangement of 7q34 shows high WBC (range 95 to 400 x 10^9/L).

Cytogenetics

Cytogenetics morphological

9q32 is a partner of 7q34. The other partners are 1p34, 1p32, 9q34, 10q24, 11p13, 15q22 and 19p13.

Additional anomalies

del(6)(q21), del(4)(q31q35).

Genes involved and proteins

TCRB (T-cell receptor beta-chain)

Location
7q35

DNA/RNA
The TRB locus at 7q35 spans 685 kb. The locus contains 2 types of coding elements: TCR elements (64-67 variable genes TRBV, 2 clusters of diversity, joining and constant segments) and 8 trypsinogen genes. A portion of the TCRB locus has been duplicated and translocated to the chromosome 9 at 9p21.

Protein
T cell receptor beta chains.

TAL2

Location
9q32

DNA/RNA
The TAL2 gene is located at q32.

Protein
TAL2 potentially encodes a basic helix-loop-helix (bHLH) phosphoprotein (size 108 amino acids) that is highly related to those specified by TAL1 and LYL1 also implicated in T-ALL. The bHLH protein interacts with the product of RBTN1 and RBTN2 (cysteine-rich LIM motifs).

Result of the chromosomal anomaly

Hybrid gene

Description
TAL2 is transcriptionaly activated by t(7;9)(q34;q32) in T-ALL. The chromosome 9 breakpoints of the t(7;9)(q34;q32) occur 33 kbp downstream of sequences that encode the TAL2 HLH domain. Translocated TAL2 are juxtaposed with transcriptional regulatory elements within the T-cell receptor beta-chain locus.

Fusion protein

Note
No fusion protein.

Oncogenesis
The TAL2 transcription is activated ectopically in lymphoid cells and the inappropriate expression of

TAL2 in these cells promotes development of T-ALL. Normaly, the TAL genes are not expressed in the thymus. The TAL genes become activated and expressed in the thymus upon chromosomal translocation which ultimately leads to the development of T-ALL.
The (7;9) translocation express a TAL2 gene product of 108 amino acids. In leukemic cells this product exists in both a phosphorylated and an unphosphorylated form. Serine residue 100 is the major site of TAL2 phosphorylation in vivo. And it serves as an effective in vitro substrate for MAP kinases such as ERK1.
TAL2 polypeptides interact in vivo with the E2A gene products to form HLH heterodimers that bind DNA, the result is the E2A inactivation. The E2A products are transcriptional factors implicated in the B and T cell development.
TAL2 product was also shown to bind with a GTP binding protein (DRG). The properties of TAL2 broadly resemble those described previously for TAL1 and therefore support the idea that both encoded proteins promote T-ALL by a common mechanism and the malignant potential of these proteins is likely to reside within their HLH domains though the inactivation of E2A.

To be noted

Case Report
Translocation t(7;9)(q34;q32) found in pediatric T-cell acute lymphoblastic leukemia.

References

Smith SD, Morgan R, Gemmell R, Amylon MD, Link MP, Linker C, Hecht BK, Warnke R, Glader BE, Hecht F. Clinical and biologic characterization of T-cell neoplasias with rearrangements of chromosome 7 band q34. Blood. 1988 Feb;71(2):395-402

Xia Y, Brown L, Yang CY, Tsan JT, Siciliano MJ, Espinosa R 3rd, Le Beau MM, Baer RJ. TAL2, a helix-loop-helix gene activated by the (7;9)(q34;q32) translocation in human T-cell leukemia. Proc Natl Acad Sci U S A. 1991 Dec 15;88(24):11416-20

Secker-Walker LM, Campana D, Hawkins JM, Sampson RE, Coustan-Smith E. Karyotype and T-cell receptor expression in T-lineage acute lymphoblastic leukemia. Genes Chromosomes Cancer. 1992 Jan;4(1):41-5

Baer R. TAL1, TAL2 and LYL1: a family of basic helix-loop-helix proteins implicated in T cell acute leukaemia. Semin Cancer Biol. 1993 Dec;4(6):341-7

Wadman I, Li J, Bash RO, Forster A, Osada H, Rabbitts TH, Baer R. Specific in vivo association between the bHLH and LIM proteins implicated in human T cell leukemia. EMBO J. 1994 Oct 17;13(20):4831-9

Xia Y, Hwang LY, Cobb MH, Baer R. Products of the TAL2 oncogene in leukemic T cells: bHLH phosphoproteins with DNA-binding activity. Oncogene. 1994 May;9(5):1437-46

Cytogenetic abnormalities in adult acute lymphoblastic leukemia: correlations with hematologic findings outcome. A Collaborative Study of the Group Français de Cytogénétique Hématologique. Blood. 1996 Apr 15;87(8):3135-42

Mahajan MA, Park ST, Sun XH. Association of a novel GTP binding protein, DRG, with TAL oncogenic proteins. Oncogene. 1996 Jun 6;12(11):2343-50

Bain G, Engel I, Robanus Maandag EC, te Riele HP, Voland JR, Sharp LL, Chun J, Huey B, Pinkel D, Murre C. E2A deficiency leads to abnormalities in alphabeta T-cell development and to rapid development of T-cell lymphomas. Mol Cell Biol. 1997 Aug;17(8):4782-91

This article should be referenced as such:

Boyer J. t(7;9)(q34;q32). Atlas Genet Cytogenet Oncol Haematol. 2003; 7(1):39-40.