+9 or trisomy 9
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Identity

Note: Occurs in a large spectrum of myeloid and lymphatic malignancies - chronic myeloproliferative disorders (CMPD), acute myeloid leukemias (AML), myelodysplastic syndromes (MDS), acute lymphoblastic leukemias (ALL) of B-lineage and of T-lineage. Strong association to the CMPD and especially to polycythemia vera (PV).

Clinics and pathology

Disease
Chronic myeloproliferative disorders

Epidemiology
All CMPD: approx. 2% of all cases, approx. 10% of all chromosomal aberrant cases. PV: around 7% of all cases, around 16% of all chromosomal aberrant cases.

Cytogenetic
One of the most frequent anomalies (with del(20q), +8, and del(13q)) in BCR-ABL negative CMPD, especially in PV and in chronic idiopathic myelofibrosis (CIMF). Additional anomalies: PV: in 50% as sole abnormality, in 50% of all cases most frequently in combination with numerical gain of chromosome 8.

Genes
+9 is assumed to represent a gain-of-function mechanism with respect to the JAK2 gene on 9p24 coding for the JAK2 kinase. Additionally, a cooperation of +9 with the V617F mutation of the JAK2 gene is hypothesized.

Prognosis
No prognostic impact according to follow-up studies of limited sample sizes.

Disease
Acute myeloid leukemia

Phenotype / cell stem origin
FAB subtypes M2, M4, M5.

Epidemiology
Frequent in combination with other chromosomal changes. Extremely rare as sole abnormality (around 0.1% of all cases).

Cytogenetic
Additional anomalies: In combination with other numerical gains (mainly +8) in simple karyotypes or in complex aberrant karyotypes (at least 3 chromosomal abnormalities).

Genes
Not known.

Prognosis
Intermediate prognosis as sole aberration or as +8,+9 in simple karyotypes. Complex aberrant karyotypes have an inferior prognosis.

Disease
Myelodysplastic syndrome
**Epidemiology**
Rare.

**Cytogenetic**
Additional anomalies: Occurrence as sole abnormality or within complex aberrant karyotype.

**Genes**
Not known.

**Prognosis**
Intermediate prognosis as sole aberration. Complex aberrant karyotypes have an inferior prognosis.

**Disease**

**B-lineage acute lymphoblastic leukemia**

**Epidemiology**
Rare in Philadelphia-positive and in Philadelphia-negative B-lineage.

**Cytogenetic**
Additional anomalies: Philadelphia-negative ALL: Occurrence in hyperdiploid karyotypes (equal or more than 47 chromosomes) mostly in combination with other numerical gains. Philadelphia-positive ALL: Rare additional change.\[+9 (chromosome painting, WCP#9 (red))\]

**Genes**
Not known.

**Prognosis**
Philadelphia-negative ALL with high hyperdiploid karyotype (equal or more than 51 chromosomes) shows a good prognosis, gain of chromosome 9 is not typical and prognostic impact of trisomy 9 in this setting unknown. In Philadelphia-positive ALL additional chromosomal anomalies probably enhance the inferior prognosis.

**T-lineage acute lymphoblastic leukemia**

**Epidemiology**
Rare, up to 4% in childhood T-ALL.

**Cytogenetic**
Additional anomalies: Occurs as sole or as combined anomaly.

**Genes**
Not known.

**Prognosis**
So far a prognostic impact could not be defined, which also might be due to the low analyzed case numbers.

**Cytogenetics**

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<th>Chromosome</th>
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<td>9R</td>
<td>+9</td>
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**References**


This article should be referenced as such: