Centromere

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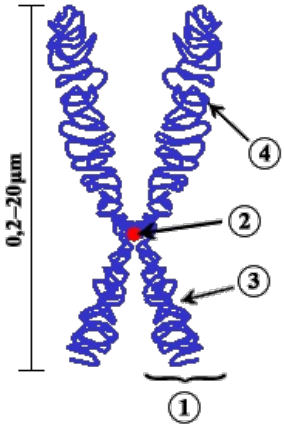
Introduction

Centromere is a region of chromosomal DNA observable on condensed chromosomeis observable as a **primary constriction** (strangulation). It is formed by a unique type of chromatin rich in typical tandem repetitive sequences (in humans, α-satellite DNA with a repeating unit of 171 bp). The centromere region is not transcriptionally active.

- In addition to many specific proteins binding to the centromere region, the protein CENP-A is present in centromeric chromatin. CENP-A replaces histone H3 in the structure of nucleosomes and only in the chromatin of active chromosomes. A kinetochore forms on CENP-A rich regions of chromatin.
- Microtubules of the dividing spindle bind to the kinetochore in mitosis and meiosis. Separation of chromatids or of chromosomes is ensured by the bipolar binding of microtubules to the kinetochores of sister chromatids. In monocentric chromosomes (as opposed to holocentric) the presence of only one binding site for the kinetochore is important for correct separation of chromosomes. The presence of multiple centromeres on one chromosome (e.g. dicentric chromosome) leads to breaks in anaphase. Defects in centromere function and kinetochore binding result in aneuploidy and chromosomal rearrangments.



- The centromere is bordered at both ends by pericentric heterochromatin, on which they are epigenetic markers (methylation of histone H3K9 and heterochromatin protein 1-HP1). The protein complex cohesin binds to pericentric heterochromatin. Cohesin mediates the cohesion of sister chromatids in the region of the centromere during mitosis.
- A **neocentromere** – a functional centromere newly formed in the region of non-centromeric DNA (nucleic acid)- rarely appears on human chromosomes. It can arise during chromosomal rearrangements, when the result is an acentric fragment. It is often associated with partial trisomy, tetrasomy or ring chromosome. A functional neocentromere may not contain α-satellite DNA, so it cannot be demonstrated by the FISH method using a centromeric probe. In several cases, neocentromeres were also found on chromosomes carrying the original centromeric DNA, which was not active.

Centromere detection methods

🔎 *For more information see Chromosome Identification .*

- C-staining;
- FISH centromeric probes, probes specific for the centromeres of individual chromosomes;
- Immunofluorescence using antibodies against centromeric proteins (e.g. CENP-C).

Links

Related Articles

- Chromosome
- Structure of the metaphase chromosome
- Telomere
- Eukaryotic chromosome
- Identification of chromosomes