Abnormalities in chromosome number, their causes and clinical presentation in man

Aneuploidies = changes in particular chromosomes number, usually ± 1 chromosome

- **monosomy** (one chromosome less, total number: 45 chromosomes)
- **trisomy** (one extra copy of chromosome, total number: 47 chromosomes)

Polyploidies = changes in chromosome number by multiples of the complete haploid set n

- triploidy (3n - three sets, total number: 69 chromosomes)
- tetraploidy (4n - four sets, total number: 92 chromosomes), etc.

Origin of aneuploidy:

- nondisjunction – failure of chromosomes to properly segregate during meiotic (or mitotic) anaphase, resulting in daughter cells with abnormal numbers of chromosomes
- nondisjunction in meiosis results in aneuploidy in the gamete, after fertilization in the zygote and then in every cell of individual
- although the frequency of aneuploid zygotes may be quite high in humans, most of these chromosomal alterations are incompatible with life, thus the embryos are spontaneously aborted in early pregnancies
- nondisjunction in mitosis results in mosaicism – an abnormal number of chromosomes in some somatic cell line of the individual
    - nondisjunction in first meiotic division – non-segregation of homologous chromosomes
    - nondisjunction in second meiotic division – non-segregation of sister chromatids

Effects on proper segregation of chromosomes/chromatids:

- **mother´s age** (long period of namely meiosis I in oocyte)
- meiotic spindle formation and function defects, recombination defects, absence of chiasmata formation (crossing over), premature sister chromatids separation

Origin of polyploidy:

- **polyploids** are fairly common in plants and invertebrates, rare in vertebrates (fish, amphibians) and not found in mammals, polyploid *mammals usually do not survive embryonic development
- specific types of human polyploid cells – e.g. in the liver, heart muscle, bone marrow
- **triploidy** is caused by:
    - dispermy – the fertilization of an egg by two sperm (more likely)
    - fertilization of an abnormal diploid gamete (produced by nondisjunction of all its chromosomes)
    - usually letal in humans, frequent finding in spontaneous abortions

Clinical presentations:

- Abnormalities in autosome number (see question No. 38 – Autosomal aneuploidy in man)
- Abnormalities in sex chromosome number (see question No. 39 – Gonosomal aneuploidy in man)