

The thesis deals with improvement and clinical application of molecular cytogenetic methods for reproductive genetics. These methods include both clinical investigations used for improvement of diagnostic and therapeutic care for infertile couples and experimental methods that can become the basis of new diagnostic tools. The thesis concentrates on the study of aneuploidies, because they constitute a major complication of human reproduction especially by means of assisted reproductive technologies.

#### Aims

The main practical aim was the introduction of fluorescence in situ hybridization (FISH) for evaluation of chromosomes in sperm, polar bodies and blastomeres for prefertilisation and preimplantation diagnosis of aneuploidies.

The main scientific objective was the study of chromosome localization in nuclei of blastomeres, that are removed from human embryos for preimplantation diagnosis. The aim of this study was to find, whether the localization of chromosomes in relation to the nuclear center and periphery is ruled by the same rules as in other cell types in later stages of development and whether the localization is influenced by aneuploidy. Next aim was to search for peripheral localization of chromosome X in embryos with more than one copies of the chromosome X. This could be a manifestation of X inactivation, that according to recent studies in mouse embryos, can be initiated already in the preimplantation phase.

#### Methods

We have used DNA probes for chromosomes 1, 13, 16, 18, 21, 22, X and Y for FISH analysis of sperm, polar bodies and blastomeres. We have also tested PNA probes (peptide nucleic acids) for chromosomes 1, 4, 9, 16, 18, X and Y and 3-dimensional digital image analysis of microscopic image. We have developed a method of measurement of chromosome signals localization using digital image analysis and a method of evaluation of the localization by comparison with a mathematical model of random distribution.