

Summary of thematically related scientific articles
„Chip-based digital PCR technology for fetal aneuploidies detection
- development, implementation of a novel diagnostic tool”

Introduction

Aneuploidies are major causes of birth defects and perinatal death. Therefore, a high risk of fetal chromosomal aberration is the most common indication for invasive prenatal diagnosis. Fetal aneuploidy is routinely diagnosed by karyotyping. The development of techniques for rapid aneuploidy detection based on the amplification reaction allows cheaper and rapid diagnosis. However, the currently available solutions have limitations. A more advanced approach that allows absolute quantification of nucleic acid with high sensitivity and specificity is digital PCR technology. Digital PCR method is based on three main points: the partition of the target, PCR on each single molecule in thousands of simultaneous reactions and Poisson statistics.

The purpose of the research was to develop of a novel chip-based digital PCR method for rapid detection of the most common fetal aneuploidies and determination of clinical performance. The next goal of the research was to define the accuracy of the new solution for detecting fetal aneuploidy in the presence of maternal cell contamination (MCC).

Materials and methods

The study was conducted in 652 pregnant women with increased risk for fetal aneuploidy undergoing invasive prenatal diagnostics. Genomic DNA extracted from amniotic fluid or chorionic villus sampling was analyzed for the copy number of chromosomes 13, 18, 21, X, and Y. For all samples, karyotype results were available for final comparison with digital PCR results.

Results and Conclusions

The published results are the first worldwide report on the use of the QuantStudio 3D Digital PCR platform for the detection of the most common fetal aneuploidies. Chip-based digital PCR method provides statistically significant discrimination between euploid and aneuploid samples with precision and accuracy even in mosaicism. A single-molecule-amplification with high sensitivity and specificity, minimum hands-on time methodology makes the digital PCR approach reliable and cost-effective rapid aneuploidy screening tool. In addition, digital PCR is an accurate method for fetal aneuploidy detection even in the presence of high level of MCC. The algorithm eliminates the need for maternal DNA and additional MCC tests, which reduces costs and simplifies the diagnostic procedure. The implementation of a novel method broadens the knowledge of the use of modern technology, allows for the improvement of diagnostic procedures, thus contributing to the optimisation of prenatal care.

Keywords: digital PCR, rapid aneuploidy detection, prenatal diagnostics, maternal cell contamination