

Review

Conventional and molecular cytogenetic diagnostic methods in stem cell research: A concise review

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Abstract

Regenerative medicine and cell therapy are emerging clinical disciplines in the field of stem cell biology. The most important sources for cell transplantation are human embryonic and adult stem cells. The future use of these human stem cell lines in humans requires a guarantee of exhaustive control with respect to quality control, safety and traceability. Genetic instability and chromosomal abnormalities represent a potential weakness in basic studies and future therapeutic applications based on these stem cell lines, and may explain, at least in part, their usual tumorigenic properties. So, the introduction of the cytogenetic programme in the determination of the chromosomal stability is a key point in the establishment of the stem cell lines. The aim of this review is to provide readers with an up-to-date overview of all the cytogenetic techniques, both conventional methods and molecular fluorescence methods, to be used in a stem cell bank or other stem cell research centres. Thus, it is crucial to optimize and validate their use in the determination of the chromosomal stability of these stem cell lines, and assess the advantages and limitations of these cutting-edge cytogenetic technologies.

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1. Introduction

Human adult and embryonic stem cells (hESC) in transplant programmes has supposed a considerable advance not only in regenerative medicine and cell therapy but also in basic biology. The potential therapeutic use of hESC derivatives requires guarantee of their quality, safety and traceability with the implementation of exhaustive quality control programmes. One of the main problems with stem cell lines of different source, mainly those of embryonic origin, is the possibility of chromosomal alterations and genomic instability which will explain, at least in part, their *in vivo* tumorigenic

potential (Ringden et al., 2003; Cowan et al., 2004; Draper et al., 2004; Menéndez et al., 2005a,b, 2006). Therefore, the introduction and the application of a strict cytogenetic programme is necessary. The study of processes such as cell-renewal, pluripotency, specific differentiation, undifferentiated associated markers, telomerase, mitochondrial, epigenetic and chromosomal stability must be considered and implemented in this emerging area of stem cell biology (Mandal et al., 2006).

The chromosomal stability in a cell line consists, mainly, of maintaining a normal karyotype both numerically and structurally, because hESC lines develop chromosomal aberrations after long-term culture indicating an unstable genomic status due to the *in vitro* culture after successive passages have been carried out (Maira et al., 2005; Calsandez et al., 2006; Ludwig et al., 2006). Human ESCs may be prone to acquiring chromosomal anomalies while being cultured continuously (*in*

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Diagnostic Cytogenetics Rolf-Dieter Wegner,2013-11-11 In addition to the traditional cytogenetics still used as the basic methodology for everyday clinical diagnosis new molecular cytogenetic techniques provide a useful basis for routine diagnosis Fluorescence in situ hybridization FISH has become a standard technique and comparative genomic hybridization CGH spectral karyotyping SKY and multi color FISH have shown their potential for diagnostic purposes Following a section on tissue culture chromosome staining and basic information about karyotyping nomenclature and quality standards protocols of relevance for comprehensive cytogenetic diagnostics are presented *Molecular Diagnostics* George P. Patrinos,Wilhelm Ansorge,2009-08-21 The 2e of *Molecular Diagnostics* the only book dealing with diagnosis on a molecular level discusses current molecular biological techniques used to identify the underlying molecular defects in inherited disease The book delves further into the principle and brief description of the technique followed by examples from the authors own expertise Contributors to the 2e are well known experts in their field and derive from a variety of disciplines to ensure breadth and depth of coverage *Molecular Diagnostics 2e* is a needed resource for graduate students researchers physicians and practicing scientists in molecular genetics and professionals from similar backgrounds working in diagnostic laboratories in academia or industry as well as academic institutions and hospital libraries Deals exclusively with the currently used molecular biology techniques to identify the underlying molecular defect of inherited diseases Includes pharmacogenetics and pharmacogenomics relating to new cancer therapies Provides a comprehensive guide through emerging concepts and demonstrates how the available mutation screening technology can be implemented in diagnostic laboratories and provide better healthcare Modern Soft Tissue Pathology Markku Miettinen,2010-06-14 This book comprehensively covers modern soft tissue pathology and includes both tumors and non neoplastic entities Soft tissues make up a large bulk of the human body and they are susceptible to a wide range of diseases Many soft tissue tumors are biologically very aggressive and the chance of them metastasizing to vital organs is quite high In recent years the outlook for soft tissue cancers has brightened dramatically due to the increased accuracy of the pathologist s tools All methods of diagnosis are covered here with an emphasis on the newest immunoassays and other genetic molecular and immunologic diagnostic modalities This book s systematic description of benign and malignant primary soft tissue tumors with didactic comprehensive panels of illustrations allows the reader to formulate a complete understanding of the morphology of tumor entities at one glance The book covers both the most common tumor entities and more unusual diseases using more than 1 500 color images making it a resource for beginning and senior pathologists Zeiss Information with Jena Review ,1992 **Prenatal genetic screening, diagnosis and treatment** Aleksandra Jezela-Stanek,Sheela Nampoothiri,Przemysław Kosinski,Ting Hu,2023-09-06

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