

Chapter 73

Advanced Approaches to Diagnose and Treat the Chronic Autoimmune Disorders: Multimodal Molecular Imaging

Tomasz Sołtysiński

InfoNanoBiophotonics Research Institute, Poland

ABSTRACT

Pathology and dynamics of particular cells and the molecular components of immune system is still challenging to be traced within living organisms. The techniques of molecular imaging (MI) are promising tools to monitor the immune system at work, to improve or allow personalized diagnostics and treatment, especially of the autoimmune diseases. In this study some possible targets for MI and biosensing are discussed. The personalized medicine, in addition to bioinformatics-based systemic approach, requires extensive research and novel high-throughput technologies like next generation of imaging, biosensing experimental systems based on microfluidics, nanotechnology, femtochemistry, superresolution (STED, STORM, PALM, SOFI, etc.), label-free imaging, spectroscopy (including TCSPC), MRI, multimodal optical methods, acoustic imaging through ultrasonic waves, nuclear medicine methods like SPECT and PET. Moreover, dedicated designs of modular Lab-on-Chip solutions are of high demand to perform multipurpose cell measurement and give a possibility to flexibly interact with sensed objects.

INTRODUCTION

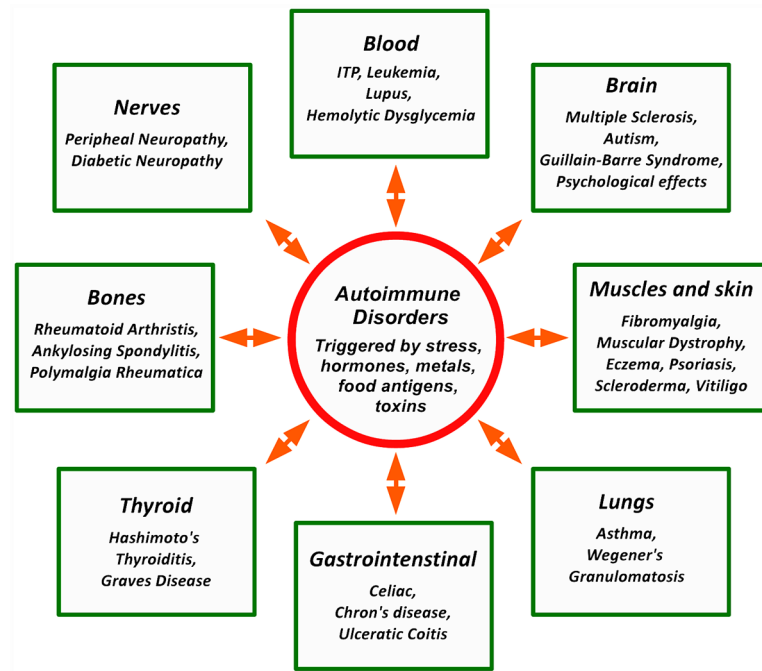
Chronic autoimmune disorders are the reason for serious complication or damage in functionality of human bodies (see fig. 1). They affect multiple parts of central nervous system (CNS); particular tissue like thyroid gland; blood cells or hematopoietic system leading often to unrecoverable damage of the target or its functionality (Betterle, Lazzarotto, & Presotto, 2004). Although some understanding of the reasons of pathology can be achieved throughout theoretical modeling using methods of bioinformatics, immunogenetics and immunomics, as recently pointed out by Brusica, Gottardo, Kleinstein, Davis and

DOI: 10.4018/978-1-5225-0571-6.ch073

Human Immunology Project Consortium steering committee (2014) and Kidd, Peters, Schadt and Dudley (2014), the study of the dynamics of particular cells and the molecular components of immune system is still hard to perform in living organisms (Garber, 2014). Among others, the techniques of molecular imaging (MI) seem to be the most promising tool to monitor the immune system at work (Zaretsky et al., 2012). In this study a review of some currently used techniques is presented and their possible applications in particular autoimmune disorders, like idiopathic or immune thrombocytopenia purpura (ITP, abnormally low platelet counts) (Badalin, 2014; Bussel et al., 2007; Peñalver et al., 2006) are discussed.

This chapter pays special focus on some advances in techniques of molecular imaging adapted to improve or allow personalized diagnostics and treatment in immunology, especially autoimmune diseases. Some of MI techniques are suitable to investigate in precision already known immunosuppressive therapies leading to understanding the underlying processes responsible for their effectiveness or its lack. As discussed, for instance, in the notes of Lydyard and Whelan (2011), a number of successful treatment methods for ITP, including intravenous gamma globulin, corticosteroids, cytostatics and monoclonal antibodies, have been proven to be clinically useful (Peñalver et al., 2006; Conrad, 2009; Conrad and Fritzier, 2007; Conrad, 2011; Conrad, Schöbler, Hiepe, & Fritzier, 2011). However, these therapies usually fail on long term scale. The molecular-cell interaction, responsible for development of autoimmune disorders of this kind are still rather poorly understood in vivo in humans and difficult or expensive to diagnose. Moreover, understanding of the complexity of epigenetic interactions leading to autoimmune disorders is still at its advent, although the epigenetics acts as a key factor in this domain (see fig. 2).

Figure 1. Organs and tissues under attack of autoimmune process, triggered by external and internal factors



28 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/advanced-approaches-to-diagnose-and-treat-the-chronic-autoimmune-disorders/159785

Related Content

Telehealth as an Innovative Supply Chain and Logistics Management Approach

Darrell Norman Burrell (2022). *International Journal of Health Systems and Translational Medicine* (pp. 1-9).

www.irma-international.org/article/telehealth-as-an-innovative-supply-chain-and-logistics-management-approach/306971

Happiness Index and Gadget Radiation Analysis on Yajna and Mantra Chanting Therapy in South Asian Continent: COVID-19 vs. Ancient Rich Culture From Vedic Science

Rohit Rastogi, Mamta Saxena, Mayank Gupta, Akshit Rajan Rastogi, Pradeep Kumar, Mohit Jain, Mukund Rastogi, Chirag Gupta, Akshit Tyagi and Prajwal Srivastava (2021). *International Journal of Health Systems and Translational Medicine* (pp. 1-46).

www.irma-international.org/article/happiness-index-and-gadget-radiation-analysis-on-yajna-and-mantra-chanting-therapy-in-south-asian-continent/270952

Application of Kirlian Captures and Statistical Analysis of Human Bioelectricity and Energy of Different Organs: Observations and Graphical Notations

Rohit Rastogi, Mamta Saxena, Devendra K. Chaturvedi, Mayank Gupta, Neha Gupta, Deepanshu Rustagi, Sunny Yadav and Pranav Sharma (2021). *International Journal of Health Systems and Translational Medicine* (pp. 10-32).

www.irma-international.org/article/application-of-kirlian-captures-and-statistical-analysis-of-human-bioelectricity-and-energy-of-different-organs/277367

AI-Driven Predictive Model: Diagnosis Approach for COVID-19 Using Deep Learning Method

Sonam Gour and Alex Khang (2024). *AI-Driven Innovations in Digital Healthcare: Emerging Trends, Challenges, and Applications* (pp. 185-199).

www.irma-international.org/chapter/ai-driven-predictive-model/338981

Diffusion of Innovations: A Foundational Theory for Medical Informatics Research

Fred K. Weigeland Benjamin T. Hazen (2014). *Advancing Medical Practice through Technology: Applications for Healthcare Delivery, Management, and Quality* (pp. 136-153).

www.irma-international.org/chapter/diffusion-of-innovations/97410