

Developing a Deep Understanding of the Immune Response in Hepatitis B Virus Infected Patients Using a Knowledge Driven Approach

Authors : Hanan Begali, Shahi Dost, Annett Ziegler, Markus Cornberg, Maria-Esther Vidal, Anke R. M. Kraft

Abstract : Chronic hepatitis B virus (HBV) infection can be treated with nucleot(s)ide analog (NA), for example, which inhibits HBV replication. However, they have hardly any influence on the functional cure of HBV, which is defined by hepatitis B surface antigen (HBsAg) loss. NA needs to be taken life-long, which is not available for all patients worldwide. Additionally, NA-treated patients are still at risk of developing cirrhosis, liver failure, or hepatocellular carcinoma (HCC). Although each patient has the same components of the immune system, immune responses vary between patients. Therefore, a deeper understanding of the immune response against HBV in different patients is necessary to understand the parameters leading to HBV cure and to use this knowledge to optimize HBV therapies. This requires seamless integration of an enormous amount of diverse and fine-grained data from viral markers, e.g., hepatitis B core-related antigen (HBcrAg) and hepatitis B surface antigen (HBsAg). The data integration system relies on the assumption that profiling human immune systems requires the analysis of various variables (e.g., demographic data, treatments, pre-existing conditions, immune cell response, or HLA-typing) rather than only one. However, the values of these variables are collected independently. They are presented in a myriad of formats, e.g., excel files, textual descriptions, lab book notes, and images of flow cytometry dot plots. Additionally, patients can be identified differently in these analyses. This heterogeneity complicates the integration of variables, as data management techniques are needed to create a unified view in which individual formats and identifiers are transparent when profiling the human immune systems. The proposed study (HBsRE) aims at integrating heterogeneous data sets of 87 chronically HBV-infected patients, e.g., clinical data, immune cell response, and HLA-typing, with knowledge encoded in biomedical ontologies and open-source databases into a knowledge-driven framework. This new technique enables us to harmonize and standardize heterogeneous datasets in the defined modeling of the data integration system, which will be evaluated in the knowledge graph (KG). KGs are data structures that represent the knowledge and data as factual statements using a graph data model. Finally, the analytic data model will be applied on top of KG in order to develop a deeper understanding of the immune profiles among various patients and to evaluate factors playing a role in a holistic profile of patients with HBsAg level loss. Additionally, our objective is to utilize this unified approach to stratify patients for new effective treatments. This study is developed in the context of the project "Transforming big data into knowledge: for deep immune profiling in vaccination, infectious diseases, and transplantation (ImProVIT)", which is a multidisciplinary team composed of computer scientists, infection biologists, and immunologists.

Keywords : chronic hepatitis B infection, immune response, knowledge graphs, ontology

Conference Title : ICSWBIT 2023 : International Conference on Semantic Web Business and Innovation Technologies

Conference Location : Jeddah, Saudi Arabia

Conference Dates : February 20-21, 2023