

Analysis of R&D Trend for the Treatment of Autoimmune Diseases by Scientometric Method

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Introduction

Autoimmune diseases (AD), referred to as abnormal immune responses of body against self-antigen, are caused by the loss of immunologic self-tolerance resulting in damage to the cells, tissues and organs. The National Institute of Health (NIH) lists more than 80 autoimmune diseases that affect varied organs of the body including rheumatoid arthritis, multiple sclerosis, systemic lupus erythematosus and so on.

Significant advances of AD have been made in the understanding of clinical and pathological mechanisms involved but, to date, a few elements have been identified as being responsible for the autoimmune process. With a better understanding of the causes and treatments of AD, many potential novel therapies have recently been developed and evaluated, focusing on cellular or molecular targets. Although there have been several research activities carried out with scientometric tools to evaluate scientific output for individual autoimmune diseases such as rheumatoid arthritis, Crohn's and Behchet's disease (Shahram et al., 2013), there was no scientometric studies on the entire autoimmune disease to date. Density-equalizing algorithms, scientometric methods and large scale data analysis were applied to evaluate quality and quantity of scientific researches in rheumatoid arthritis (Schöffel et al., 2010). Various scientometric analysis including literature-related discovery (LRD), text-mining was more broadly performed to produce knowledge discovery such as gene expression and proteomic studies. Data mining and bioinformatics approaches for autoimmune biomarker discovery studies were also attempted (Kostoff, 2014).

The purpose of this study is to analyze the status and trends of treatments for AD using scientometric methods, and intend to give researchers and policy-makers valuable information in the field of AD.

Data and Methods

Publications associated with the treatment of AD were retrieved from Elsevier's SCOPUS database. The query to collect data for scientometric analysis was as follows: "TS=(autoimmun*) AND

TS=(therap* OR treatment*)" Total 23,587 articles published during recent 10 years (2004-2013) were collected and analyzed. Microsoft Excel, KITAS, NetMiner and VOSviewer software were combined to analyze bibliometric data. KITAS software from KISTI (Korea Institute of Science and Technology Information) was used for data extracting and cleaning. NetMiner and VOSviewer software were also used for clustering and mapping.

Results and Discussion

Figure 1 shows R&D trends over time in major countries, and the share and CAGR (compound annual growth rate) of each country based on scientific papers regarding treatments of AD. Over the last 10 years, there has been a significant growth in performance of papers with CAGR 10% in this field. Although the US quantitatively represents the largest share (23.4%), China shows the most rapid CAGR 26.6% followed by Korea (13.2%). Especially in the field of AD, Japan and Germany show a strong tendency compared with other general aspects of pharmaceuticals.

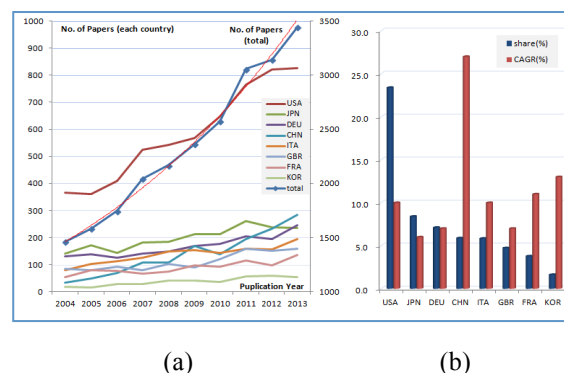


Figure 1. The changes of number of papers (a) and the share and CAGR by major countries (b).

2-mode network in Figure 2 shows the co-occurrence between main countries and keywords extracted from papers, which can help identifying; which country related to; which kind of autoimmune diseases or therapeutics or treatment technologies. Circle nodes represent countries and the size of each node indicates the number of publications. The degree of relationships is

indicated by the thickness of the link and the distance between two nodes.

Keywords are divided into 2 groups, different types of AD at the bottom of Figure 2 and its technical terms at the top. In terms of the disease, high prevalence of AD including rheumatoid arthritis, multiple sclerosis, type I diabetes have shown a high correlation with US. Japan is estimated to be active in the field of autoimmune pancreatitis, autoimmune hepatitis, and Germany seems active in multiple sclerosis and type I diabetes. In particular, autoimmune thyroiditis shows a high correlation with Japan, Germany and Italy rather than US. As shown in the top of Figure 2, US is very active across all areas of the field. Advanced immunotherapies with cell-based technologies using dendritic cell, regulatory T cell (T-reg) are particularly revealed to be active in Japan and Germany as in the US.

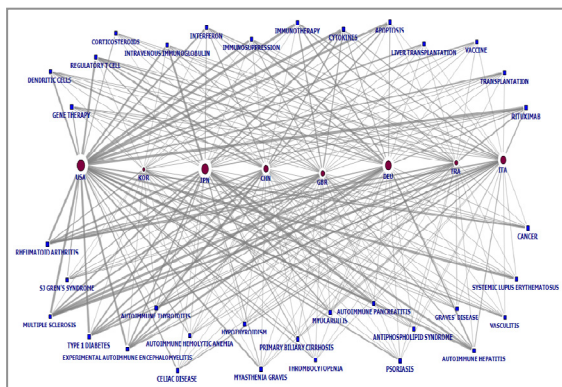


Figure 2. 2-mode network of the major countries and keywords related to autoimmune diseases.

Figure 3 provides the knowledge mapping for AD treatment drawn by co-word analysis, which shows the hot topic field or an increasing R&D productivity trend for AD treatment. To find out changes in R&D trends for treatment of AD, the dataset was divided in two time periods: 2004 to 2006 and 2011 to 2013. Several changes are found in the map of the past 3 years (2004-2006) compared with the last 3 years (2011-2013).

Figure 3 shows an experimental study using experimental autoimmune encephalomyelitis (EAE) animal model of multiple sclerosis has been disappeared in the last map (2011-2013). As time passed, clinical studies on many diseases considered to be autoimmune have been conducted with various organs and systems including endocrine, hepatobiliary, vascular systems. In addition, cell-based immune therapies with regulatory T cell (T-reg) or Th17 cells gradually have emerged in the last map (2011-2013). Immunomodulatory effects of mesenchymal stem cell (MSC) are also shown in the second figure of Figure 3. This might imply that a targeted immune therapy had been developed and successfully utilized in treating AD patients.

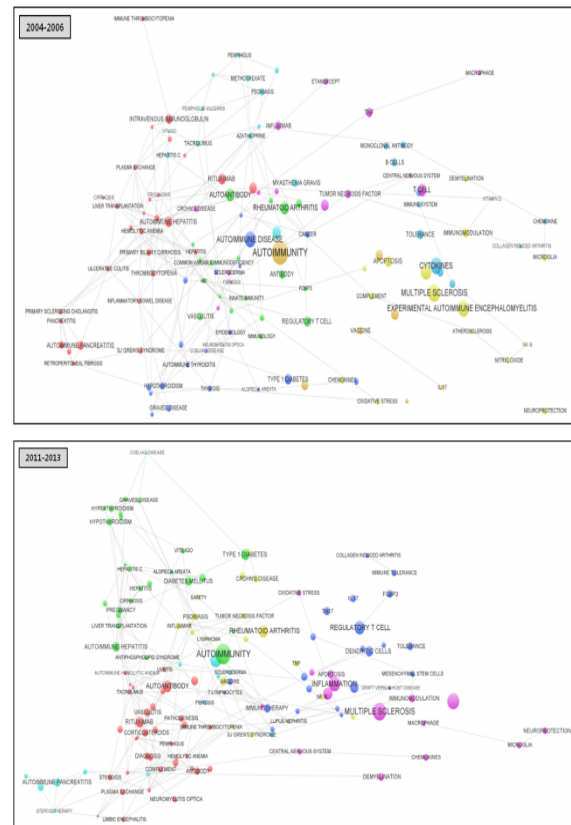


Figure 3. Co-word knowledge mapping product for the treatment of autoimmune disease.

In this study, we investigated present R&D status and trend for the treatment of AD using scientometric analysis methods. The trend in advanced R&D for the treatment of AD was identified through knowledge mapping techniques such as co-word analysis of articles and visualization technology. The results show that each country has progressive development of AD therapeutics with any other aspect. Additionally, the approach to identify the molecular and cellular mechanisms of AD underlying the immune tolerance has been increased.

References

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