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Research Article

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Retinopathy of Prematurity and Bioinformatics Analysis: Bibliometric Studies and Visual Analysis by Cite Space

Fu Zheng, Yang Hui*, Wei Xixiang, Xiong Weiwei, Yin Xue, Fang Weifang and Li Xiuting

Ophthalmology, Xiamen Branch of Pediatric Hospital, Fudan University Ophthalmology, China

***Corresponding Author**
Yang Hui, Ophthalmology, Xiamen Branch of Pediatric Hospital, Fudan University Ophthalmology, China.

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Abstract

Objective: *The study aims to explore the hotspots and frontiers of retinopathy of prematurity (ROP) and bioinformatics analysis by reviewing the current status by Cite Space.*

Methods: *The Web of Science database (WoS) was searched from ROP to 2010. Cite Space is used to generate network maps about the collaboration between authors, countries and institutions and to reveal hotspots and frontiers of both.*

Results: *98 studies related to ROP and various bioinformatics analyses were retrieved from WoS. North-Eastern University and Massachusetts General Hospital are the major countries and institutions. Hot topics focus on the interaction between the two, and possible new diagnostic and control measures.*

Conclusion: *based on the results of the Cite Space study, scholars suggest that the deepening of the authors, positive cooperation between countries and institutions, mainly committed to research including artificial intelligence deep learning and the mutual recognition of biological information, especially through vascularization, additional lesions, classification and gene expression, this may mean that the future may be rapid and accurate diagnosis of ROP, especially invasive retinopathy of premature maturity (A-ROP).*

Keywords: Retinopathy of Preterm, Bioinformatics Analysis, Bibliometry, Visual Analysis, Cite Space, Review

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1. Background

Retinopathy of prematurity (retinopathy of prematurity, ROP) is a developmental vascular proliferative lesion with the main pathological changes are stagnant retinal vascular development and abnormal local vascular proliferation [1]. Invasive retinopathy of prematurity (auto-retinopathy of prematurity, A-ROP) is the most serious type of retinopathy of prematurity, characterized by severe PLUS lesions, inner retinal vascular shunt, rapid progression to retinal detachment, etc., hypoxia-induced retinal neovascularization is the most important pathological link. With the development of perinatal medicine and neonatology, the survival rate of preterm infants improves, the number of children with ROP continues to increase, and the incidence of ROP is particularly high. ROP can cause severe visual impairment and even blindness, accounting for 6% to 18% of the causes of blindness in children [2].

Although cryotherapy, laser photocoagulation, and adjuvant anti-vascular endothelial growth factor (VEGF) drugs lead to significantly reduced morbidity and improved outcomes, the treatment of disease prevention and resurrection remains difficult. The key issue is that the physiopathologic mechanisms of ROP remain poorly understood. Current bioinformatics tests, such as miRNA, artificial intelligence, etc., may provide a new basis for the prediction and treatment of ROP.

Cite Space Is a software that can conduct visual analysis of scientific literature, and can intuitively show the distribution and rules of knowledge structure in a certain scientific research field [3,4]. Through Cite Space, our research focused on the network of authors, countries and institutions; common citation analysis; coexisting keywords and cluster analysis; emergence of keywords, exploring the research hotspots and trends of bioinformatics for ROP.

2. Materials and Methods

2.1. Data Collection

With "ROP" as the Bioinformatics testing theme words, In the core database in Web of Science, Time is set to "2010-2023", Select the paper types as "Article" and "Review", Other literature types such as "Editorial Material", "Meeting Abstract", "Early Access", "Letter", and "Retracted Publication" were excluded. It was imported into Cite Space in TXT plain text and full record format and analysed after weight.

2.2. Study Methods

Use Cite Space 5.6. R5 (64-bit) to measure the countries, institutions, journals, keywords, co-cited references, and make visual analysis and generate the corresponding map. Graphting annual publications in the field retrieved on Web of Science using Excel 2010 and statistical analysis of bibliometrics derived from Cite Space. The parameters of Cite Space are set as follows:

1) Time Partition: 2010-2023;
2) Time Slice: 1 year;
3) Selection Gtandard: g index;
4) Visualization: Cluster view-static, showing the merged network;
5) Network Cropping: path finding network, cropping the network of each slice, and clipping the merged network.

3. Results

3.1. Distribution of Literature Quantity

A total of 98 documents were retrieved between 2010 and 2023. In the course of the biological information analysis of ROP, the number of publications increased between 2010 and 2023 [5-10]. After bibliometric and visual analysis of the countries and regions by Cite Space, it was found that several countries or regions with the largest number of publications were China, India, the United States, Taiwan, China, Australia, Germany, Italy, etc. China (including Taiwan, China) posted more than twice India's. At the same time, countries represented by China, India, the United States and Australia will play a "leading role" in the development of this field. China and Australia have relatively close cooperation, including the United States and Spain, and India, Germany and the Netherlands.

3.2. Distribution of Research Institutions

After visual analysis of research institutions in this field, it was found that the institutions with the most publications were North-eastern University, Oregon Health and Science University, Massachusetts General Hospital, Guangzhou Women and Children's Medical Center, Shenzhen University, and Shandong University. It can be seen that the United States is the main position of this research, and three of the top three research institutions with the largest publications are all in the United States. However, from the map of cooperation between institutions, the cooperation between institutions is mainly regional, and there is a lack of sufficient exchanges and cooperation between institutions of different countries [11-13].

3.3. Distribution of Published Journals

In terms of journals, it is mainly ophthalmology, followed by engineering and paediatrics. By name and impact factor, the most journals; the journals are from America and Europe, especially in the United States [14-16]. The journal with the highest impact factor is the Dutch "JOURNAL OF PETROLEUM SCIENCE AND ENGINEERING". Besides, most journals have an impact factor of around 3 to 5 points. Both American and European journals have an absolute advantage in this field, either in terms of the number of articles or the impact factors Table 1.

Rank	Journal	Count	Percentage	Import factor	Country
1	JOURNAL OF PETROLEUM SCIENCE AND ENGINEERING	8	10.00%	4.4	NETHERLANDS
2	JAMA OPHTHALMOLOGY	5	6.25%	8.1	USA
3	PEDIATRICS	5	6.25%	8	USA
4	INVESTIGATIVE OPHTHALMOLOGY VISUAL SCIENCE	4	5.00%	4.4	USA
5	JOURNAL OF ENERGY RESOURCES TECHNOLOGY TRANSACTIONS OF THE ASME	4	5.00%	3	USA
6	TRANSLATIONAL VISION SCIENCE TECHNOLOGY	4	5.00%	3	USA
7	ACS OMEGA	3	3.75%	4.1	USA
8	DIAGNOSTICS	3	3.75%	3.6	Poland
9	ENERGIES	3	3.75%	3.2	SWITZERLAND
10	FRONTIERS IN PEDIATRICS	3	3.75%	2.6	SWITZERLAND

Table 1: Top 10 Journals in the Research Field

3.4. Co-Cited Literature Analysis

Among the top ten literature with total citations, seven were on the diagnostic of deep convolutional networks applied to ROP [17-20]. The highest total citation number (up to 57) was in Brown JM Table 2.

Number	Title	Author	Year	Count
1	Automated Diagnosis of Plus Disease in Retinopathy of Prematurity Using Deep Convolutional Neural Networks.	Brown JM, et al	2018	57
2	Automated retinopathy of prematurity screening using deep neural networks.	Wang JY, et al	2018	23
3	Evaluation of a deep learning image assessment system for detecting severe retinopathy of prematurity.	Redd TK, et al	2019	23
4	Monitoring Disease Progression with a Quantitative Severity Scale for Retinopathy of Prematurity Using Deep Learning.	Taylor S, et al	2019	20
5	Plus, Disease in Retinopathy of Prematurity: Improving Diagnosis by Ranking Disease Severity and Using Quantitative Image Analysis.	Kalpathy-Cramer J, et al	2016	20
6	Automated Analysis for Retinopathy of Prematurity by Deep Neural Networks.	Hu JJ, et al	2019	19
7	Computer-Based Image Analysis for Plus Disease Diagnosis in Retinopathy of Prematurity: Performance of the & quot; i-ROP & quot; System and Image Features Associated with Expert Diagnosis.	Ataer-Cansizoglu E, et al	2015	16
8	Plus, Disease in Retinopathy of Prematurity: A Continuous Spectrum of Vascular Abnormality as a Basis of Diagnostic Variability.	Campbell JP, et al	2016	16
9	Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs.	Gulshan V, et al	2016	16
10	Screening Examination of Premature Infants for Retinopathy of Prematurity.	Fierson WM, et al	2018	16

Table 2: Top 10 articles of Co-Citation Times in the Research Fields of Keratoconus on Controlling Biomechanics from 2010 to 2023

3.5. Research Trends and Hot Spot Analysis

Using Cite Space to select keywords as nodes, and using its emergent word analysis function can reveal the research trend and hot spots of bioinformatics applied in the pathogenic mechanism field of ROP. In this field, the early experiment is based on the study of ROP pathogenesis, inducing factors and protein structure, later began to clinical treatment of randomized controlled trials and some meta-analysis, the recent hotspot mainly in the deep study of artificial intelligence, big data of biological information, namely to research and development such as i-ROP DL application in the diagnostic application of A-ROP, so as to explore the relationship between the two [14,21-26].

4. Discussion

This study utilized Cite Space to analyse the Web of Science (WOS) core database over a period of nearly 10 years, focusing on the application of bioinformatics in retinopathy of prematurity (ROP) research. The analysis included examination of annual publication volumes, prominent research countries and regions, leading research institutions, major publishing journals, representative literature, research hotspots, and emerging frontiers. The findings suggest that scholars have significantly increased their research efforts in the intersection of retinopathy and bioinformatics over the past decade. Based on the observed trends, it is anticipated that bioinformatics research in the context of drug development for ROP will continue to be a highly active area of study. This study through the Cite Space of Web of Science (WOS) core database in nearly 10 years on bioinformatics applied in ROP research, published literature documentation and visual analysis, from the annual volume, major research countries and regions, research institutions, major publishing journals and representative literature, research hotspot and frontier conducted a more comprehensive analysis, the following conclusions [27,28].

Scholars have conducted extensive and in-depth research on the field of retinopathy and bioinformatics analysis of prematurity, and the number of articles has been on the rise in the past 10 years. According to the law of scientific research, it can be speculated that the bioinformatics research will continue to maintain A high heat in the field of drug research and development of A-ROP [29].

Research on the application of bioinformatics analysis has formed a major center in China, the United States and India. In terms of the number of articles, the United States has the largest number of articles, and the number of intermediaries is relatively high, indicating that the United States has been continuously carrying out some high-quality research in this field. In addition, according to the visual map of the national cooperation, the connection between the research centers is not close, indicating that there is not much cooperation between the research centers.

Among them, China, New Zealand and Germany are relatively close ties, indicating that the above regions have certain cooperation in this field. However, Australia, Canada, the United States and other countries have less cooperation with Asian countries, so the cooperation between countries and regions should be strengthened. From the point of research institutions, bioinformatics analysis in the field of prematurity retinopathy research mainly in some high-level research institutions, however, the research institutions mainly regional for their respective research circle, geographical location close to cooperation between research institutions, geographical location is almost no contact with each other, lack of full exchanges and cooperation. The top three research institutions were all in the United States, such as North-eastern University, Oregon Health and Science University, and Massachusetts General Hospital. It can be seen that the United States is the main position of this research and has a prominent position in the research field. Next, there are some research institutions in China and India.

As for the research of bioinformatics analysis in the application field of ROP, most of its publishing journals are well-known journals of ophthalmology and engineering. Although the countries, regions and research institutions with the largest number of publishing are mainly in the Americas, the publishing house is mainly located in the United States. Because this field is mainly in ophthalmology and paediatrics, it shows that the United States still dominates the field. Representative journals in the field such as (JAMA OPHTHALMOLOGY), (PEDIATRICS), (INVESTIGATIVE OPHTHALMOLOGY VISUAL SCIENCE) are all derived from the Americas. Through the analysis of keywords, we can understand the research hotspots and trends of bioinformatics analysis in the application field of ROP from the perspective of emerging words. It is mainly divided into three stages, the characterization of fundus images and the classification of A-ROP, the pathogenic mechanism and the selection of treatment methods and the current research focus on the deep learning of fundus images for the diagnosis and prevention of diseases [14].

In the early basic research, scholars are keen to focus on vascular endothelial growth factor inhibitors and their pharmacokinetics, monotherapy, and effects on the systemic system. The research of vascular endothelial growth factor inhibitors is mainly focused on the following aspects [5-7,9-14].
1) Selection of drugs: including bevacizumab, ranizumab, and Compacept.
2) Differences in the efficacy of laser and drug therapy.
3) Drug measurement: drug measurement selection for various clinical trials.
4) Pharmacokinetics and its effects on various systems of the whole body. The introduction of artificial intelligence has created a new understanding of the diagnosis and treatment of ROP among scholars at home and abroad.

It mainly focuses on
1. The development of deep learning artificial intelligence, such as i-ROP DL system, which has high accuracy for clinical detection. There is a wider range of ROP diagnostic categories for accuracy, particularly A-ROP [30,31].
2. Deep learning of convolutional neural networks, where automatically matched ROP vascular severity scores obtained from posterior polar fundus images of ROP patients effectively distinguish disease progression in infants undergoing ROP screening. Scholars have studied disease severity better than their rated areas, especially for A type of A-ROP. This also means disease screening, as well as its use to track disease progression over time [14].
3. The severity score generated by the AI development system of deep learning detects the severe ROP based only on the vascular morphology of the posterior pole. Therefore, scholars are more committed to re-determine the ROP diagnostic score of the screening model based on the ICROP classification. If all ROP patients need and can identify emergency interventions, future iterations of AI could provide an automated screening trial to identify children with clinically significant ROP [31-34].

To sum up, ROP research is a field of ophthalmology, paediatrics and engineering, and the development and breakthrough of this field cannot be separated from the joint efforts of multiple disciplines. In the next few years, artificial intelligence and pharmacodynamics is still the research trend of ROP, domestic scholars can study around the hot spots, at the same time should grasp the hot spots and trend change, further advantage, strengthen the cooperation between countries, institutions, improve the quality of research, at the same time efforts to promote the scientific research applied to clinical practice, for the health of the new-born.

5. Conclusion

Based on the results of the Cite Space study, scholars suggest that the deepening of the authors, positive cooperation between countries and institutions, mainly committed to research including artificial intelligence deep learning and the mutual recognition of biological information, especially through vascularization, additional lesions, classification and gene expression, this may mean that the future may be rapid and accurate diagnosis of ROP, especially invasive retinopathy of premature maturity (A-ROP).

This paper analyses the shortcomings and phased achievements in its research, and reveals the research trend in this field and the current research hotspot, which can provide certain reference value for relevant personnel for further research in this field.

Authors Contribution

Fu Zheng prepared and designed the experiment; implemented the study; collected the data; analysed and interpreted the data; wrote the paper; revised it according to the revision opinions of the editorial department.

Yang Hui to critically review the intellectual content of the article.

Fang Weifang and Wei Xixiang analyse and interpret the data.

Xiong Weiwei critical of the intellectual content of the article

Yin Xue analyze and interpret the data

Li Xiuting analyze and interpret the data reference documentation

Conflict of Interest

The author declares that this study was conducted without any commercial or financial relationships, these relationships can be explained as potential conflicts of interest.

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Ethics Approval

The study was approved by the ethics committee of Xiamen Pediatric Hospital affiliated with Fudan University, Xiamen, China (approval no: XPH 2023-16).

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