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REVIEW

Regional Anesthesia (2012–2021): A Comprehensive Examination Based on Bibliometric Analyses of Hotpots, Knowledge Structure and Intellectual Dynamics

Abdullah Shbeer

College of Medicine, Jazan University, Jazan, Saudi Arabia

Correspondence: Abdullah Shbeer, College of Medicine, Jazan University, Jazan, Saudi Arabia, Tel +966505769570, Email Ashbeer@jazanu.edu.sa

Abstract: In the last decade, there has been a significant advancement in the area of regional anesthesia (RA). Continuous evaluation of research in any developing field using modern technologies and available software is critical to identify future trends, hot spots, and intellectual dynamics. The current study was designed to bibliometrically evaluate the global research in RA using VOSviewer, MS Excel, and CVS-Scopus bibliographic data (2012–2021). Knowledge structure and intellectual dynamics were analyzed using clustering of keyword co-occurrence. Literature screening in the last decade found 6092 original articles (96.1%) and conference papers (3.9%). The top four countries producing articles were the United States (n = 30.57%), India (7.51), the United Kingdom (7.22%), and Canada (6.06%). A significant positive correlation was found in global publication productivity (R^2 = 0.9161). The most productive organizations were Harvard University, the University of Toronto, and the Hospital for Special Surgery – New York. A tremendous collaboration was spotted nationally and internationally, especially in pediatric RA. This comprehensive study, which summarizes and evaluates 6902 original research materials on regional anesthesia, may serve as a resource for anesthesiologists, physicians, researchers, and students.

Keywords: regional anesthesia, bibliometrics, VOSviewer, knowledge structure, intellectual dynamics

Introduction

Regional anesthesia (RA) is the use of local anesthetics to suppress pain sensations in a wide part of the body, such as an arm, leg, or abdomen.[1] RA permits an operation to be performed on a specific area of the body while you remain awake.[2] RA benefits from new medications, medical equipment, and ultrasonography, which decrease the incidence of serious problems and boost the technique's efficacy and practicality.[3] The peripheral blockade has evolved to produce better and safer outcomes via the use of skin landmarks, nerve stimulation, percutaneous electrode guiding, and ultrasound imaging. Even more, anesthesiologists are attempting to provide comprehensive pain management with peripheral continuous nerve blocks to enhance postoperative outcomes. Peripheral nerve blocks and epidural and spinal anesthesia are the most common RA procedures. Peripheral nerve blocks are procedures in which a local anesthetic is administered near a particular nerve or bundle of nerves to block pain sensations in the region of the body served by the nerve. Most nerve blocks are used for operations on the arms and hands, legs and feet, groin, or face. In epidural and spinal anesthesia, a local anesthetic is administered near the spinal cord and main nerves that enter the spinal cord to block pain sensations from an entire area of the body, such as the lower abdomen, hips, or legs.[4,5] Compared to general anesthesia, the usage of regional anesthetics is growing due to early mobilization, high analgesic levels, shorter hospital stays, and reduced postoperative nausea and vomiting. Though it is widely assumed that RA is more dependable than general anesthesia, particularly in senior patients, no substantial difference in mortality and morbidity has been proven between the two anesthetic methods.[6]

Bibliometric analysis is a quantitative tool for analyzing the impact of research outputs such as articles and books. Bibliometric analysis may help identify future research collaboration across nations, organizations, or authors in emerging research topics. Citation analysis examines how many times works by a certain author, nation, or journal are referenced by others, revealing the impact of a particular author, country, or journal on a given subject. Various bibliometric studies in the health sector have been done with the recent growth in publication numbers. Articles included in typical bibliometric analyses in this unique research in the literature may be identified utilizing databases such as Web of Science and Scopus. In addition to WoS and Scopus, which cover a wide range of disciplines, there are numerous specialized databases available online as well. These include PubMed (for the medical and biomedical fields), Chemical Abstracts, Mathematical Reviews, the ACM Digital Library (for the computer sciences), and CiteSeer (for the computer and information sciences).[7,8]

Although RA rather than general anesthesia has increased in recent years, there are scarce systematic bibliometric investigations on this issue in the literature. One previous bibliometric study was conducted for research published from 1980 to 2019, in which the Web of Science database was used.[9] Therefore, as it is known, updating bibliometric studies and diversifying the use of databases are necessary steps in monitoring and analyzing all kinds of research. The purpose of this study was to conduct a bibliometric analysis of documents published in the Scopus database on RA between 2012 and 2021 to determine which countries, organizations, and authors are influential, international cooperation, and the most cited articles and journals in this field. The keyword analysis aimed to identify current research topics and trends related to RA.

Materials and Methods
Database Selection and Search Strategy
To search for bibliographic content and examine bibliometric indicators, researchers often utilize databases such as Google Scholar, Web of Science, and Scopus.[10] Even though an understanding of the basic characteristics of these services is required for effective literature searches and determining whether their indicators are appropriate for use in research evaluations, the differences between these databases in terms of coverage and data reliability are a major factor in the selection. Web of Science and Scopus' selective method results in a curated collection of documents, yet it is susceptible to biases in the selection criteria. There are some coverage differences in these three data sources across subject categories.[10] The current study used the Scopus database for its broader coverage in health sciences compared to WOS and effective Boolean search terms.[10] Entering either British or American spellings (colour, color, or tyre, tire) in the Scopus search engine will search for both variations. An unconditional search was initially performed using the TITLE-ABS-KEY (*regional* AND *anesthesia*) (Figure 1). 34,807 documents were retrieved (1901–2022) (Table 1). This study focuses on the previous decade (2021–2021). 6902 English-language research documents were obtained from the journal's original articles and conference papers. Data for citation and bibliographical information, abstract, keywords, and funding details were exported in the CSV file.

Analysis, Mapping and Visualization of Bibliographic Data
Mapping and visualization of bibliographic data were performed using VOSviewer software. This is a software application for creating and displaying bibliometric networks, which may be based on citation, co-citation, or co-authorship relationships. VOSviewer also has text mining capabilities, which may be used to build and display co-occurrence networks of key phrases retrieved from the scientific literature. VOSviewer was used to obtain knowledge structure, hotspots, research impact, important topics, and collaborative research.[11,12] Top-productive authors, journals, institutions, countries were obtained using MS Excel. Regression analysis feature in MS Excel was used to estimate fitting parameters between years and research production.

Results
The first scholarly production related to RA was in 1901, and it was about local and regional anesthesia in rectal operations.[13] This paper is considered the inception RA's research. Since then, about 34,807 research documents have been published until the moment of writing this paper. From 2012 to 2021 represents 34% of the total scholarly production. A holistic assessment of global research (N=6902) using articles (96.9%) and conference papers (3.1%) produced in English in the last decade (2012–2021) was performed in this study. Books and review articles were not incorporated into our study. A review article is based on previously
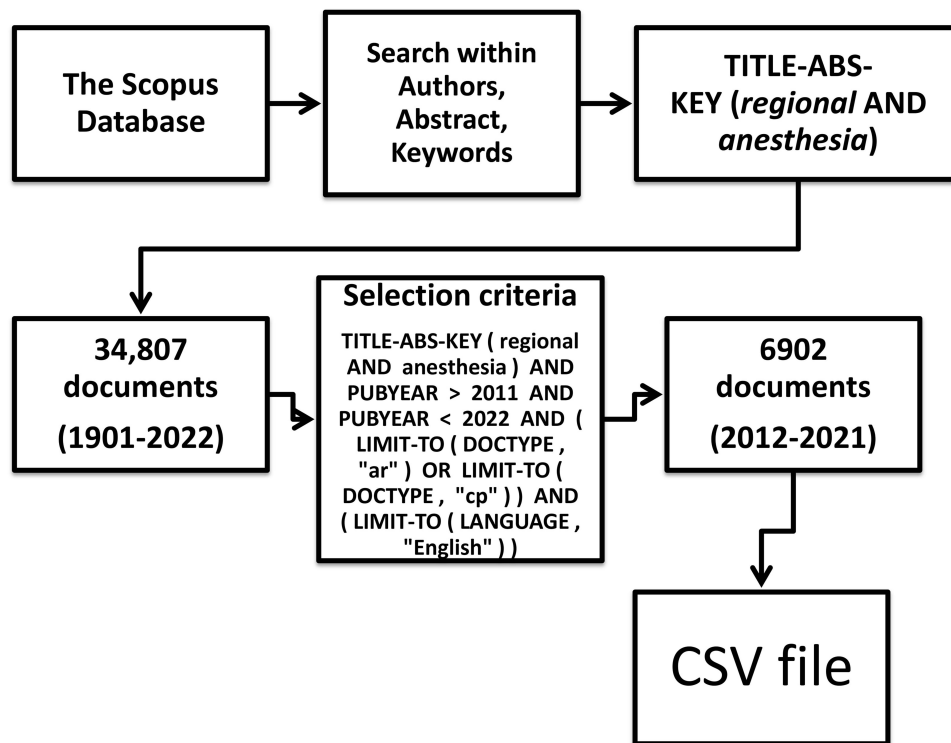
Figure I Search approach used in this study.

published works. It does not include any original research. In general, review articles summarize the available literature on a subject to describe the present level of knowledge on the issue.

The polynomial regression equation was modeled between the number of publications and the years. An R^2 value of 0.9161 showed a trendy incrimination in the knowledge discourse in RA based on years (Figure 2). 140 countries have contributed to enriching RA knowledge, while the USA is the main contributor with 30.05% of the total global research in RA, followed by India (7.51%), the UK (7.22%), Canada (6.06%), Turkey (5.09), China (4.64%), Germany (4.23%), and Italy (4.04%) (Figure 3). In a previous bibliometric study on RA, it was noted that some countries had become more

Table I Scholarly Production in Regional Anesthesia

| Document Type	1906–2022		2012–2021	
	Number	**Percent**	**Number**	**Percent**
Article	24,854	71.41	7399	62.56
Review	4571	13.13	2051	17.34
Letter	2366	6.80	1038	8.78
Editorial	836	2.40	381	3.22
Conference Paper	813	2.34	217	1.83
Book Chapter	513	1.47	376	3.18
Note	402	1.15	210	1.78
Short Survey	318	0.91	73	0.62
Erratum	95	0.27	56	0.47
Book	27	0.08	18	0.15
Conference Review	7	0.02	5	0.04
Retracted	3	0.01	1	0.01
Undefined	2	0.01	2	0.02
	34,807	100	11,827	100
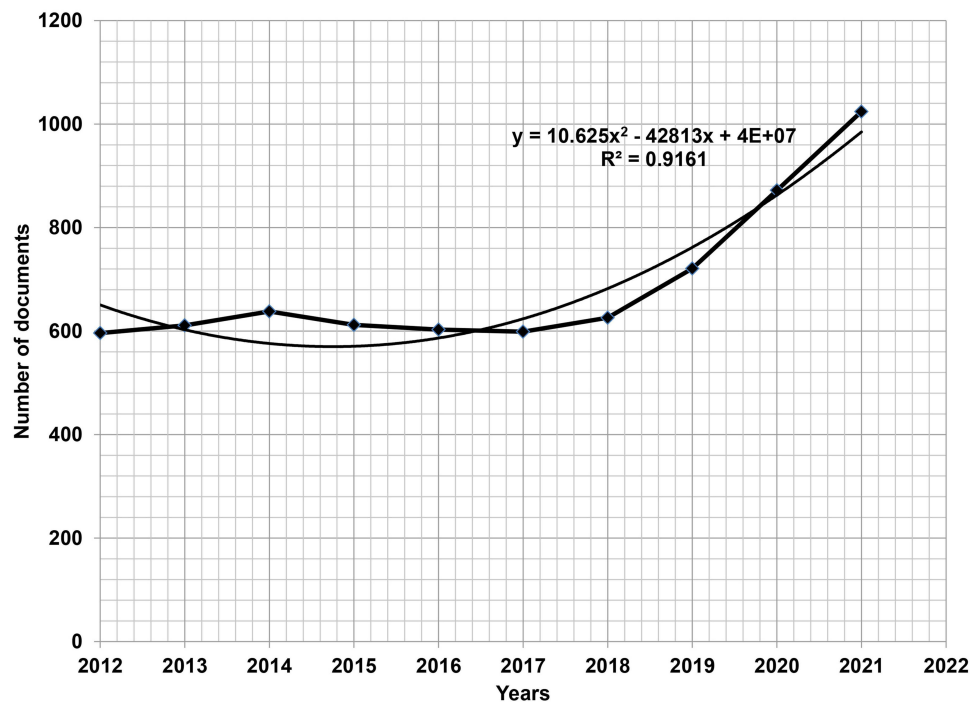
Figure 2 Annual production in regional anesthesia. Regression analysis was performed to estimate fitting parameters between annual trends and research production.
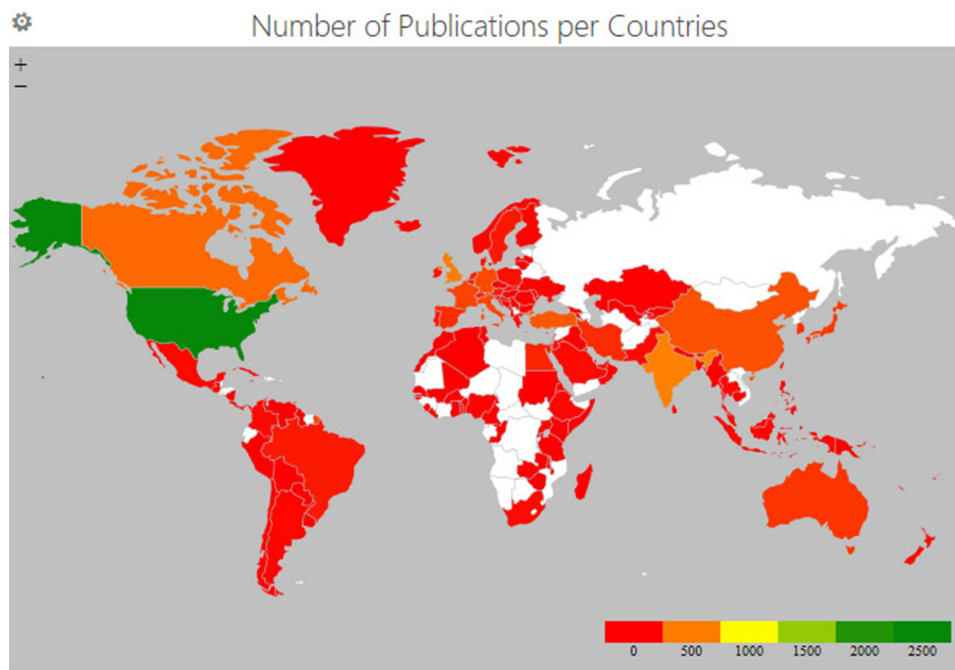

Figure 3 The geographic density of research documents.

productive and occupied an advanced position in this decade.[9] The dominance of Western countries in this study resulted from the prevalence of RA research among their academic and medical organizations. Harvard Medical School represented the most productive institute with 150 scholarly discourses. It is followed by the University of Toronto (Canada), Hospital for Special Surgery - New York, Stanford University School of Medicine, Mayo Clinic, and Cleveland Clinic Foundation (USA). There are about 25,000 universities globally, but note that RA research is restricted

to only 160 (0.64%). Cairo University and two universities from Iran are the only institutes in the Middle East outside America and Europe.

Moreover, as scholar's participation in RA research, we noted that Mariano, affiliated to Anesthesiology and Perioperative Care Service, Palo Alto, USA, is the top-publishing scholar (N=56), as his research started in 2004, in which he published a paper on anesthesia concerns for robotic laparoscopy in infants.[14] His most cited paper is about the effect of continuous ambulatory femoral nerve block on decreasing time to discharge readiness after total knee arthroplasty.[15] They are 594 scholars who participated in RA knowledge generation, and Table 2 depicts the top-publishing authors. Mariano, E.R. and Kim, T.E. affiliated to VA Palo Alto Health Care System, Palo Alto, USA, are among the top-ten authors (Table 2). Rosenberg, P.H. (Department of Anesthesiology, Helsinki University Central Hospital, Finland) was the top-publishing author (N=49) in the period between 1980–2019.[9]

A total of 27 subject areas accommodated RA research. 75.79%of the entire knowledge was generated by researchers from the subject area of medicine. Biochemistry, Genetics and Molecular Biology (5.35%), Veterinary (3.59%), Nursing (2.61%), Neuroscience (2.59), and Pharmacology, Toxicology and Pharmaceutics (2.42%) are the major fields.

Citation and Research Impact

Research quality is complex, with significant features including plausibility/soundness, originality, importance, and social worth. Citations are becoming more popular as performance metrics in research policy and the research system. Citations are often thought to represent the influence or quality of the study. In recent years, bibliometric indicators have been more widely used in the context of research assessment and, more broadly, research policy. Citation indicators may be used to assess the scientific performance of research groups, departments, and institutions and evaluate research proposals, allocate research money, and hire academic professionals. Citation metrics are also essential indications in various university rankings, including the Leiden ranking and the Academic Ranking of World Universities. Citation counts alone cannot explain why other scholars often reference a particular article.[16–18] Numerous citation indicators have been established over the last several decades, and there has been much disagreement concerning the most effective methodologies for computing citation indicators, normalization processes, database coverage, and data quality. The most commonly used citation indicators are the field-normalized citation impact indicator, the number/proportion of highly cited publications, and the h-index. Citation counts therefore reflect a very narrow notion of "impact." Citation counts do not reflect the influence of publications on anything else; rather, they simply gauge how beneficial or influential articles are to the authors of other works. One cannot determine from a manuscript's citation count alone if the paper documented a substantial change in clinical practice that considerably improved patient outcomes, a novel approach to data analysis, or a timely review of the body of research.[18,19] Accordingly, VOSviewer analyzed citations for authors, documents, sources, institutions, and countries. Direct citation, number of documents, and total link strength for authors are shown in Figure 4 and Table 3. Out of 29,356 authors, 594 and 50 received 5 and 15 citations, respectively. Mapping of the author's citation data revealed six clusters with 328 links and total

Table 2 Top-Productive Authors

Rank	Author	Affiliation	TP	C	T/C
1st.	Mariano, E.R.	VA Palo Alto Health Care System, Palo Alto, USA	56	583	10.41
2nd.	Memtsoudis, S.G.	Hospital for Special Surgery - New York, Department of Anesthesiology, New York, USA	49	1530	31.22
3rd.	Tobias, J.D.	Nationwide Children's Hospital, Columbus, USA	28	144	5.14
4th.	Howard, S.K.	Stanford University School of Medicine, Department of Anesthesiology, Stanford, USA	25	268	10.72
5th.	Poeran, J.	Icahn School of Medicine at Mount Sinai, Institute for Healthcare Delivery Science, New York, USA	23	363	15.78
6th.	Steinfeldt, T.	Germany Universitäts klinikum Frankfurt, Department of Anesthesiology, Frankfurt am Main, Germany	23	349	15.17
7th.	Chin, K.J.	University of Toronto, Department of Anesthesiology and Pain Medicine, Toronto, Canada	22	833	37.86
8th.	Gabriel, R.A.	University of California, San Diego, Department of Anesthesiology, San Diego, USA	22	141	6.41
9th.	Kim, T.E.	VA Palo Alto Health Care System, Palo Alto, USA	22	233	10.59
10th.	Urman, R.D.	Harvard Medical School, Department of Anesthesiology, Boston, USA	22	228	10.36

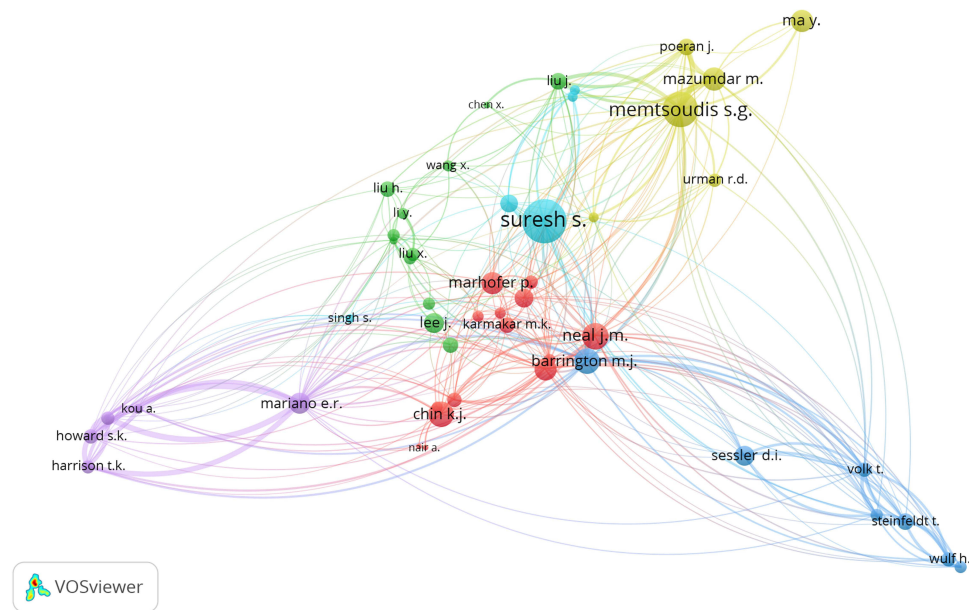**Abbreviations**: TP, Total publication; C, Citation; T/C, Total citation.

Figure 4 Networks of authors' citation having fifteen or more citations. Only 50 authors were mapped. The size of the nodes represents the number of citations received by the authors.

link strength of 1570. Cluster one (red) is anchored by Neal, affiliated with the Department of Anesthesiology, Virginia Mason Medical Center, USA. Neal's research is in local anesthetic and systemic toxicity. Lee, J. is the top-cited scholar in the second cluster (green), affiliated to Department of Anesthesiology and Pain Medicine, Busan Paik Hospital, Inje University College of Medicine, Korea, and studied anesthesia for ambulatory surgery and pediatric surgical procedures.[20,21] Cluster three (blue) is led by Barrington, M.J. (Northeast Health Wangaratta, Australia), whose research is in ultrasound-guided regional anesthesia.[22–24] Cluster four (yellow) is anchored by Memtsoudis, S.G. Memtsoudis (Hospital for Special Surgery - New York, Department of Anesthesiology, New York, USA) is the only author who is present in both Tables 2 and 3, and his direct research initiatives focused on cardiopulmonary physiology, sleep apnea, perioperative care, and population-based outcomes research.[25–27] Mariano, E.R. is the leading author in cluster five (purple). It also noticed that the top-cited authors are members of The General Anaesthesia compared to the Spinal Anesthesia (GAS) trial. This is a randomized clinical trial evaluating neurotoxicity in children exposed to anesthesia for inguinal hernia surgery.[28,29] From this citation analysis, it could

Table 3 Top-Cited Authors

Author	Affiliation	Documents	Citations	Total Link Strength
Suresh S.	Department of Pediatric Anesthesiology, Children's Memorial Hospital, USA	21	2402	749
Memtsoudis S.G.	Hospital for Special Surgery - New York, Department of Anesthesiology, New York, USA	49	1530	707
Wu C.L.	Department of Anesthesiology and Critical Care Medicine, The Johns Hopkins Hospital, Baltimore, Maryland.	12	1407	90
De Graaff J.C.	Division of Anesthesia, Intensive Care and Emergency Medicine, University Medical Center Utrecht, Utrecht, the Netherlands.	12	1282	580
Morton N.S.	Paediatric Anaesthesia & Intensive Care, ALB/Karolinska University Hospital, Stockholm, Sweden	8	1221	501
Disma N.	Department of Anaesthesia, Istituto Giannina Gaslini, Genova, Italy.	10	1211	562
Bell G.	Department of Anaesthesia, Royal Hospital for Children, Glasgow, Scotland, UK.	5	1093	413
Frawley G.	Anaesthesia and Pain Management Research Group, The Royal Children's Hospital, Melbourne, Australia.	9	985	571
Szmuk P.	Department of Anesthesiology, University of Texas, Houston Medical School, USA.	8	981	593
Mccann M.E.	Department of Anesthesia, Children's Hospital and Harvard Medical School, USA.	8	944	547

be concluded that pediatric regional anesthesia is a hot spot, as we find that Suresh, the most-cited researcher, specializes in pediatric anesthesia, as is the case for most researchers in Table 3.

Top-cited documents are shown in Table 4. Barr J. and her research group published the top-cited article entitled "Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit" and published in Critical Care Medicine.[30] Regional Anesthesia and Pain Medicine is the top-cited journal (N=10255), as shown in Table 5 and Figure 5. Five institutions had more than 500 citations, namely, Stanford University School of Medicine (USA), University of Melbourne, Royal Children's Hospital, Princess Margaret Hospital for Children, University of Western Australia (Australia), and University of Washington (USA). The USA (N=34787), Canada (N=11462), UK (9161), Germany (4319), Italy (4107), and Australia (N=4107) received the highest number of citations.

Collaborative Research

Many of today's most pressing scientific and technological problems may be resolved by bringing together interdisciplinary teams of researchers, clinicians, and experts. It is possible to do remarkable studies when disparate areas are brought together. It is thus possible to describe collaborative research as research that involves collaboration between the researchers, institutions, organizations, and/or communities. Projects benefit from this collaboration because it provides a unique perspective.[31,32] VOSviewer was utilized to examine the collaborative research using its two co-authorship measures. These two properties are called the Links and Total link strength attributes, respectively. There are two properties for a specific object: Links and Total Link Strength. The Links property indicates the number of connections a researcher has with other researcher and the total link strength. When it comes to co-authorship, the Links attribute shows how many times a particular researcher has collaborated with other scholars. The Total Link Strength of a researcher's co-authorship ties with other researchers is represented by the total link strength attribute.[11] As shown in Figure 6, the collaborative research in RA was clustered on the author level. Six clusters were observed based on their co-authored documents. The purple cluster is the research group from Stanford University, with Mariano E. R. being the most collaborative researcher. Kessler, Liu, Memtousdis S, Barrington, Sala-Balanch, and Diwan S. are the leading authors in their respective clusters. Department of Orthopedic Surgery, Rush University Medical Center (USA), Department of Anesthesia and Pain Management, Royal Children's Hospital, and Department of Pediatrics, University of

Table 4 Top-Cited Documents

Rank	Document	Title	Journal	C	C/Y
1st.	Barr J. (2013)	Clinical practice guidelines for the management of pain, agitation, and delirium in adult patients in the intensive care unit	Critical Care Medicine	2237	248.55
2nd.	Chou R. (2016)	Management of postoperative pain: A clinical practice guideline from the American pain society, the American society of regional anesthesia and pain medicine, and the American society of anesthesiologists' committee on regional anesthesia, executive committee, and administrative council	Journal of Pain	1273	254.60
3rd.	Simons M.P. (2018)	International guidelines for groin hernia management.	Hernia	594	198
4th	Davidson A.J. (2016)	Neurodevelopmental outcome at 2 years of age after general anaesthesia and awake-regional anaesthesia in infancy (GAS): An international multicentre, randomised controlled trial.	The Lancet	531	106.20
5t	Blanco R. (2013)	Serratus plane block: A novel ultrasound-guided thoracic wall nerve block.	Anaesthesia	421	46.77
6th	Blanco R. (2012)	Ultrasound description of Pecs II (modified Pecs I): A novel approach to breast surgery	Revista Espanola de Anestesiologia y Reanimacion,	309	30.90
7th	Ellis A. (2013)	Neuroinflammation and the generation of neuropathic pain.	British Journal of Anaesthesia	291	32.33
8th	Habre W. (2017)	Incidence of severe critical events in paediatric anaesthesia (APRICOT): a prospective multicentre observational study in 261 hospitals in Europe.	The Lancet Respiratory Medicine	276	46.5
9th.	Polaner D.M. (2012)	Pediatric regional anesthesia network (PRAN): A multi-institutional study of the use and incidence of complications of pediatric regional anesthesia.	Anesthesia and Analgesia	231	23.10
10th.	Jæger P. (2013)	Adductor canal block versus femoral nerve block for analgesia after total knee arthroplasty a randomized, double-blind study.	Regional Anesthesia and Pain Medicine	221	24.55

Abbreviations: C, citations; C/Y, citation average per year.

Table 5 Top-Cited Journals

Journal	N	C	C/N	IF-2020	Citescore 2020
Regional Anesthesia and Pain Medicine	436	10,255	23.52	6.288	7.9
British Journal of Anaesthesia	130	3983	30.64	9.166	11.3
Anesthesia and Analgesia	153	3539	23.13	5.178	7.0
Anaesthesia	86	2177	25.31	6.955	10.1
Anesthesiology	53	1820	34.34	7.892	8.5
Anesthesiology and Pain Medicine	118	1370	11.61	0.438	1.9
Paediatric Anaesthesia	104	1167	11.22	2.556	3.3
Journal of Clinical Anesthesia	101	1099	10.88	9.452	7.0
Canadian Journal of Anesthesia	59	1032	17.49	5.063	6.1

Abbreviations: N, number of publications; C, citations; C/N, citation over number; IF, Impact factor.

Melbourne (Australia) are the most collaborative institutions. The US, UK, Canada, Germany, France, Italy, Australia, according to their respective Total Link Strength (Figure 7), are the most collaborative countries.

Co-Citation Mapping

A frequently used bibliometric network study that helps explain the connections or interactions between two authors is a co-citation network. Co-citation, formerly known as "co-cited", happens when a third author cites two authors simultaneously. The most co-cited authors are substantially distributed using a network diagram in this network.[33] To construct a meaningful and interpretable network, we imposed a minimum edge of 200 co-citations for each author, and the outcome showed that 52 out of 227,423 authors fulfilled this barrier. The research indicates four distinct co-citation networks among the authors, each represented by a different hue cluster (red, green, yellow, and blue) (Figure 8). The nodes (with the author's name) that are close together within the same color suggest a high degree of resemblance between the authors, while the nodes that are further apart indicate a lesser degree of similarity. The co-citation network among the authors is scattered, as seen in Figure 8. The red cluster is led by Montorsi, and Giuliano, who represent relatively high co-citations compared to the other clusters. H. Kehlet leads the red cluster's co-citation network. The most often co-cited authors are R. Brull, V.W. Chan, J.M. Neal, A. Hadzic, and P. Marhofer.
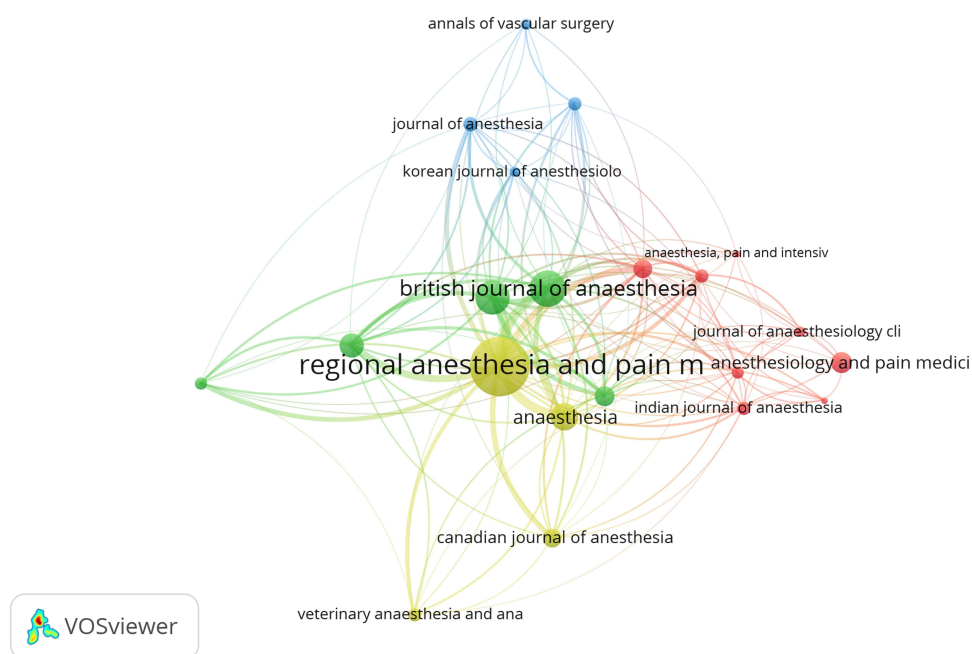

Figure 5 Networks of journals' citation having 50 or more citations. Only 21 journals were mapped. The size of the nodes represents the number of citations received by the journal.
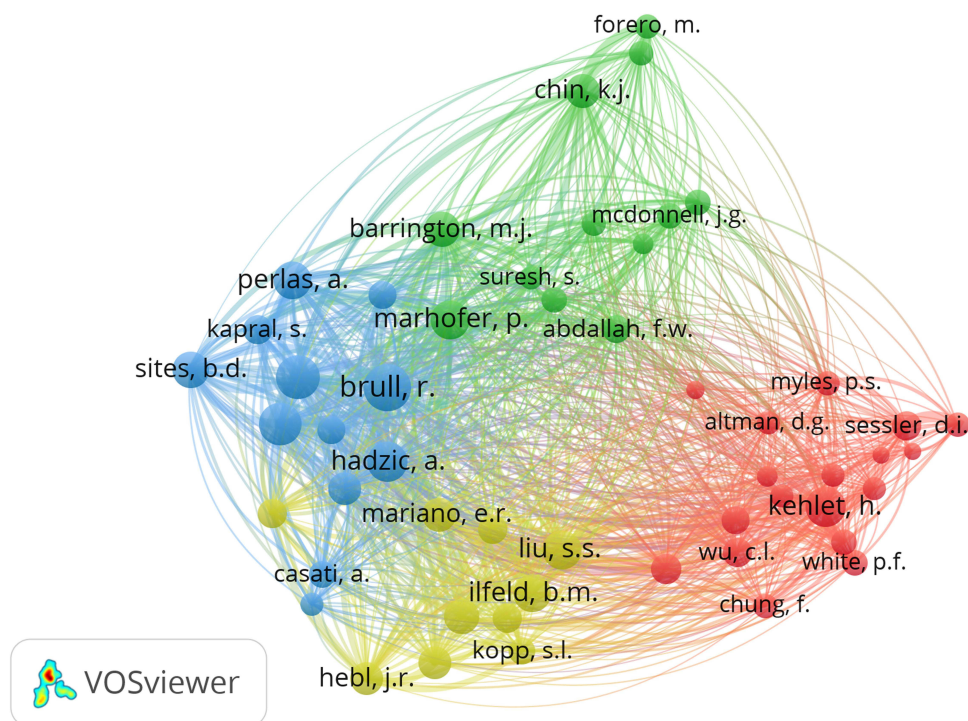
Figure 6 Networks of co-authorship with 10 co-authored documents. Only 46 authors were mapped. The size of the nodes represents the number of co-authored documents.

Figure 7 Networks of co-authorship with 20 co-authored documents. Only 46 countries were mapped. The size of the nodes represents the number of co-authored documents.

Figure 8 Co-citation network based on authors.

Syntactic Network

Syntactic networking was conducted using co-word analysis feature in VOSviewer. The software used the text data to construct a network of co-occurrence links between terms presented by authors. Author keywords are chosen by the author(s) which, in their opinion, best reflect the contents of their document. Data-mining and text-mining disciplines have grown in popularity as a result of the rise in data and scholarly texts.[11,34] Both fields have a natural tendency to explore for patterns in enormous amounts of data. Although data mining offers a viable alternative, intellectual property protection and a lack of open-source data seem to be insurmountable short-term challenges. Text mining, on the other hand, has some intriguing benefits, since what authors write in their papers is frequently written in natural language, and the majority of their content is free access (eg, titles, abstracts, keywords, etc.).[34] The current study revealed that out of 10,098 author's keywords, 129 of them occurred 20 times. These keywords were mapped using VOSviewer software. However, regional anesthesia as keywords was removed from the analysis to allow the emergence of other words. Figures 9 and 10 shows the network and overlay visualization. Overlay visualization was used to assess the frequency the author keywords development over time during the last decade (2012–2021). Regarding the dynamics of the author keywords, the last ten years are characterized by showing few changes with respect to the analysis of the total frequency. It indicates that the "ultrasound" is quite stable over time (Figure 10). Both words, "nerve block" and " postoperative pain", have a hegemonic position. There are some keywords that appear in the recent years. These words are directly associated with the RA. Therefore, their appearance among the most cited words in the last decade may be strengthened, due to the growing concern with RA research.

Figure 9. depicts the co-occurrence network among authors' keywords based on network visualization and indicate the important research topics. Four clusters (green, red, blue, and yellow) were constructed:

Cluster A: The green cluster shows that ultrasound is the predominantly used keyword in this group and is co-occurred with 31 keywords such as nerve block, pain, management, acute pain, bronchial plexus, brachial plexus block, education, local anesthesia, opioid, etc.
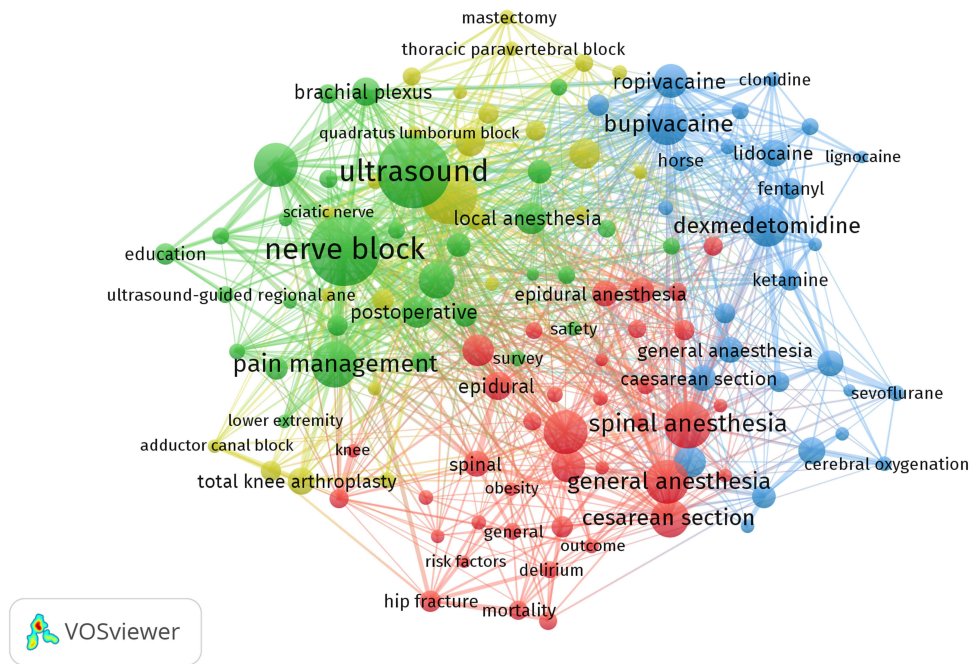
Figure 9 Co-occurrence network among authors' keywords based on network visualization.
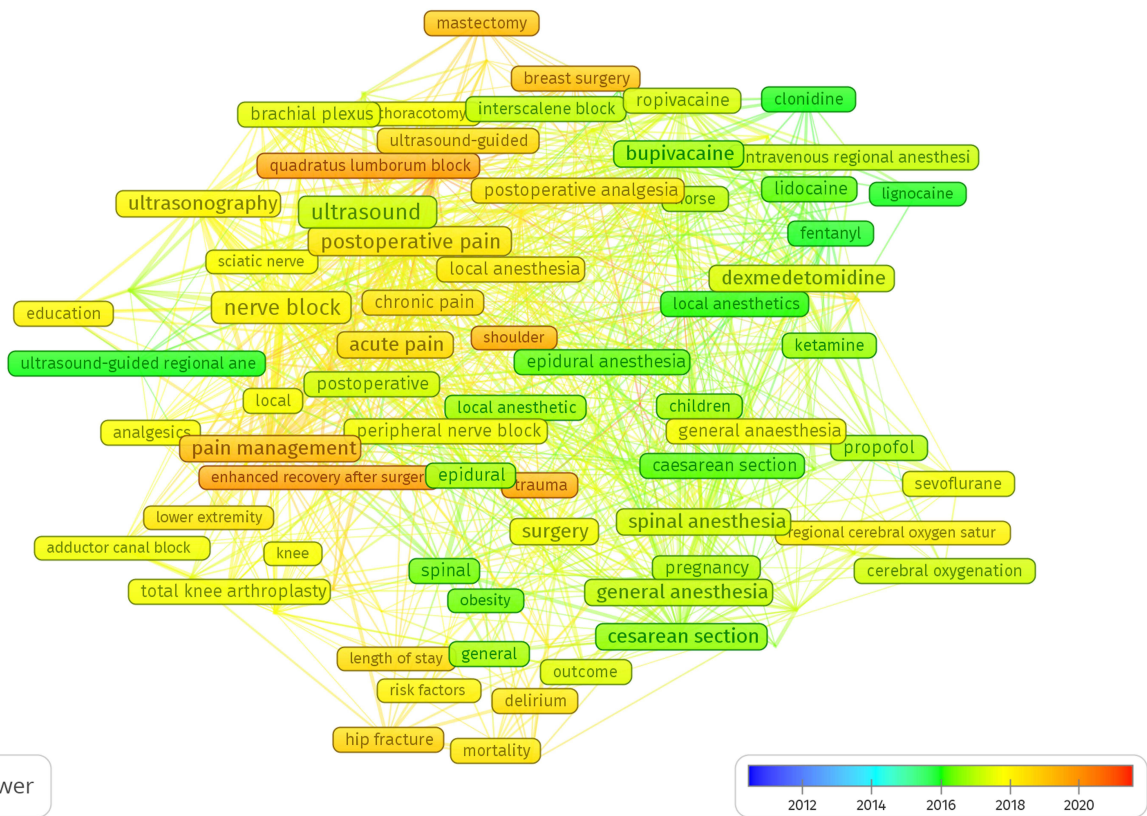

Figure 10 Co-occurrence dynamics among authors' keywords based on overlay visualization.

Cluster B: Spinal anesthesia is the most dominant keyword in the red cluster. It has a wide-ranging co-occurrence network with epidural anesthesia, general anesthesia, surgery, cesarean section, complications, pediatric, peripheral nerve block, etc.

Cluster C: The third cluster is represented in blue mainly focuses on anesthetic agents used in RA such as bupiivacaine as, and it has co-occurrence connections with dexmedetomidine, ropivacaine, lidocaine, fentanyl, propofol, etc.

Cluster D: The yellow cluster shows that postoperative pain is the predominantly used keyword in this group and is co-occurred with total knee arthroplasty, multi-model analgesia, postoperative analgesia, transversus abdominis plane block, mastectomy, etc.

Discussion

This bibliometric research highlighted the hotspots, knowledge structure, and intellectual dynamics around the RA. First, the performance study looked at how RA research has changed over the previous decade, specifically regarding the number of papers published each year. According to the temporal analysis, the study of RA is an old issue. Researchers have been more interested. Although the first publication on RA was published in 1901, academic contributions increased significantly during the previous century, reflecting RA's global prominence. We also employed source network analysis to identify the most notable researchers, their significant contributions, and the most often cited academic sources, which aided in constructing the intellectual groundwork for the study of RA across time (Fortuna et al, 2020). Understanding the contributions of the most significant academics and their influence on developing a certain study topic opens up additional options for other relevant researchers to participate.[35] Simultaneously, this research aids in identifying future sources of RA scholarship that will be important. It might aid physicians and researchers in contributing to pertinent concerns in a certain field of study. A trend toward more global assessments of RA research will provide new opportunities in regional anesthesia-analgesia outcomes in the upcoming decade.

The authors, their connected institutions, and the nations that have contributed to the study of RA via academic contributions on the issue were identified in the present analysis. Furthermore, the co-collaboration and co-citation analysis look at the underlying connections between the contributors, their studies, institutions, and countries. The relatively high overall number of published publications suggests that RA contributions are acceptable but that additional research is needed in various areas. Furthermore, the geographic distribution of the papers implies that this research discourse is being advanced internationally. Furthermore, in the RA literature, the USA, India, and the UK have been recognized as the top three contributing nations. Lexical network analysis was used to identify relevant keywords and research topics that affected the evolution of RA research and knowledge, highlighting current study areas and potential future additions to scientific understanding in this subject. As a result of the investigation, it was discovered that writers in RA academic products utilize a variety of keywords.

Conclusion

As the trend toward less invasive surgical procedures develops, anesthetic solutions that reduce systemic opioid doses, speed postoperative problems, and allow same-day discharge will become more popular. In the past 10 years, the area of RA has advanced dramatically. New anesthetic regimens for different operations have also been established, as well as improved post-surgery recovery. Understanding the most influential academics and their impact on RA allows other relevant scholars to contribute. Under RA, there have been a lot of different researches done on ultrasound, pediatric anesthesia, narcotic medications, pain relief and how to manage it even after surgery, and the use of RA in knee surgery. This study also helps discover future RA scholarship sources. It may help clinicians and researchers address current issues in a particular area of study. In the approaching decade, additional worldwide RA research evaluations will open new doors in regional anesthesia-analgesia results. Using VOSviewer, Microsoft Excel, and CVS-Scopus bibliographic data, the current study aimed to provide a bibliometric evaluation of worldwide RA research (2012–2021). Cluster analysis of keywords was used to examine the intricacies of knowledge organization and the dynamics of thought. 6092 unique articles and conference papers were discovered through a search of the literature published during the past 10 years (3.9%). The United States, India, the United Kingdom, and Canada made up 30.57%, 7.51%, 7.22%, and 7.22%, respectively, of the world's top article-producing countries (6.06%). World-wide publishing output was shown to be positively correlated with overall productivity ($R^2 = 0.9161$). The top three most productive institutions were located in the United States: Harvard University, the University of Toronto, and the Hospital for Special Surgery in New York

City. In the field of pediatric RA, in particular, there was evidence of extraordinary cooperation on a national and worldwide scale. Anesthesiologists, clinicians, researchers, and students may find this study useful since it summarizes and assesses 6902 pieces of original research on regional anesthesia.

Limitation of the Study

This bibliometric analysis has some limitations. For example, it only examined data from one database (Scopus); adding additional major databases would most certainly broaden the scope of this review. Second, our study only included English-language papers, implying that there is likely significant RA literature in other languages that were not included. Third, our analysis only included peer-reviewed journal articles; considering other publications such as books, book chapters, and so on would give more information. Fourth, our study excluded local publications that did not have indexing and online access, which may have resulted in more accurate findings. Finally, since the nature of the search terms limits the output of the review, it is likely that if additional words or texts, such as particular country names, were added, the scope of the study would be increased.

Disclosure

Author declares no conflict of interest.

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