The global publication trend and research development of nerve block: A visualisation analysis between 1997 and 2021

Xiang Dong

Shanghai Ninth People's Hospital

Pengcheng Zhao

Shanghai Ninth People's Hospital

Hui Zhao

Huashan Hospital

Jinxing Liu

Shanghai Ninth People's Hospital

Jie Chen (✉ chenjie.1011@shsmu.edu.cn)

Shanghai Ninth People's Hospital

Research Article

Keywords: nerve block, research trends, visualization analysis, WOS database

Posted Date: June 17th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1206580/v2>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: Nerve block is a clinical technique for relieving pain during surgery as well as for postoperative analgesia and chronic pain. Here, we analysed the trends in nerve block research and compared the contributions from different countries, institutions, journals, and authors.

Methods: We extracted all studies concerning nerve block published between 1997 and 2021 from the Web of Science database. Microsoft Excel and VOSviewer were used to collect publication data, analyse publication trends, and visualize relevant results.

Results: A total of 6,437 publications with 111,612 citations were identified between 1997 and 2021. The United States contributed the greatest number of publications (2010), whereas China ranked second (518). Regional Anesthesia & Pain Medicine had published the most papers concerning nerve block. Harvard University and Mariano ER were the most productive institution and author, respectively, in the field. Keywords were categorized into five clusters: the association between nerve block and anaesthesia or analgesia, local anaesthetic drugs for nerve block, nerve block techniques, nerve block for postoperative analgesia, and nerve block for oral local anaesthesia. Management-related research was a heavily researched topic in the field.

Conclusions: We concluded that the United States contributed the most studies, and developing countries, led by China, are also encouraging study in this area. The exploration of new drugs in the fields of nerve block, multi-modal analgesia after surgery, treatment of chronic pain, analgesia for thoracic and abdominal surgeries, and analgesic interventions in oral therapy are a potential focus for future research.

Introduction

Nerve block refers to the temporary blocking of the nerve conduction function by injecting local anaesthesia and adjuvant drugs around the nerve trunk; it includes central and peripheral nerve blocks (PNBs). Nerve block has a history of approximately 100 years and remarkable progress has been made in the last decade (1). Previously, nerve block techniques were used for relieving pain during the surgical period and their application gradually extended to other fields, such as postoperative analgesia and chronic pain, including chronic headache and low back pain (2, 3). Nerve block techniques have been developed through blind exploration operations based solely on localisation through the application of nerve stimulators (4) and ultrasound imaging technology (5). An ultrasound-guided brachial plexus block was first reported in 1978, with a success rate as high as 98% (6). Ultrasound-guided nerve blocks no longer block the superficial nerve trunk but have gradually developed to block the deep nerve plexus, which cannot be accessed from the surface of the body. The injection pattern of nerve blocks has also improved from single injection to continuous injection (7). Because of its safety, reliability, good analgesic effect, and the reduction in the amount of general anaesthetic drugs used, nerve block has become one of the most important methods for assisting general anaesthesia and for postoperative analgesia.

Bibliometrics is an optimal approach to quantitatively and qualitatively evaluate the achievements and trends of different research activities in a specific field over time. Bibliometric analysis can demonstrate the cross and cooperation between different countries, authors, and hotspots in some research fields in recent decades. VOSviewer (Leiden University, Leiden, The Netherlands) constructs and visualises data, which can couple keywords, authors, units, countries, and articles in the literature through clustering and constructing views to analyse the relationships among them.

Although nerve block techniques have made great progress and the frequency of nerve block use has been increasing, there is still no systematic bibliometric analysis that provides an overview of the development of nerve blocks over the decades. Thus, the present study involved a bibliometric analysis of published literature on nerve blocks from 1997 to 2021, presenting a history of the advances in this field and providing supporting evidence to determine the future research direction and development trend for nerve blocks. VOSviewer was used to determine which countries, organisations, and authors had published the most studies, and to identify the articles and journals with the highest international collaboration in this field. In addition, recent hotspots and research trends in this field were identified through keyword analysis. The present analysis contributes to characterising and predicting development in a specific field and comparing contributions among countries, institutions, journals, and authors.

Methods

We searched through the Web of Science (WOS) Core Collection database; removed irrelevant articles, such as reviews, letters, duplicates, and retractions; and assessed and verified the data entry and collection independently. Differences between the two researchers' verifications were discussed to reach a consensus. Finally, the two researchers manually cleaned and analysed the data using Microsoft Excel (Redmond, Washington, USA). Publication sources were collected from 1997 to 2021. The keywords included were 'nerve block', 'nerve blocking', 'nerve blockade', 'nerve blockades', and 'nerve blocks'. All literature searches and screening began on 31 September, 2021, to prevent search bias in the database. The following indexes were included: Science Citation Index-Expanded, Social Sciences Citation Index, Arts and Humanities Citation Index, Conference Proceedings Citation Index (CPCI)-Science, CPCI-Social Science & Humanities, Emerging Sources Citation Index, Current Chemical Reaction-Expanded, and Index Chemicus. The VOSviewer (version 1.6.13) program was used to visualise the bibliometric network. The data were extracted carefully, including titles, publication dates, countries and regions, institutions, authors, keywords, publishing journals, sums of citations, and H-indexes. Subsequently, the data were imported into Microsoft Excel 2010 and VOSviewer and quantitatively and qualitatively analysed.

Results

The total literature screened included 12,851 published items, of which 6,211 were excluded based on the type of publication (reviews, editorials, letters, case reports, bibliographies, news items, book chapters, editorial materials, notes, corrections, biographical items, book reviews, correction additions, retracted publications, and proceedings papers). The study also excluded 203 studies written in non-

English languages (Figure 1). Finally, we performed a bibliometric analysis of 6,437 published articles. There were 111,612 citations (85,922 excluding self-citations), and the H-index of the articles was 114, with 17.34 average citations per item.

Publication by country and international cooperation

The literature included articles from 108 countries. The world map showing country-wise publications on nerve blocks is shown in Figure 2. The countries producing more than 100 articles were the United States (2010), China (518), Canada (345), India (423), Turkey (404), England (303), South Korea (289), Japan (259), France (239), Italy (199), Australia (158), Spain (129), Egypt (128), Brazil (125), Switzerland (124), Austria (117), and Iran (107). The network map shows the instances of international cooperation for more than 10 articles from 53 countries (Figure 3).

Journal publication and publication trend

A total of 1,205 journals published 6,437 articles over 25 years. Microsoft Excel 2010 was used to generate the prediction model $f(x) = ax^2 + bx + c$ to calculate cumulative publications and the trend to predict future studies, as shown in Figure 4. Among these journals, there were 50 journals with at least 15 articles on the topic. Table 1 details the article and citation details of the top 20 journals with the most published articles. Regional Anesthesia & Pain Medicine published the most, with 399 papers (6.19%), followed by Anesthesia & Analgesia, with 301 papers (4.68%); the British Journal of Anaesthesia, with 133 (2.06%); and Anesthesiology, with 128 (1.98%). Acta Anaesthesiologica Scandinavica had the least published papers among the journals that had published more than 100 articles, with 108 (1.67%) (Figure 5).

Active organisations and authors

The top 20 organisations and the articles produced by these organisations are listed in Table 2. Harvard University, USA had the highest number of publications (195, 3.029%), followed by the University of California System, USA (170, 2.641%). Among the top 20 institutions identified in this field, 17 were in the United States and the others were in Canada, England, and Egypt.

The top 20 authors producing the published articles are listed in Table 3. The authors from American make the greatest contributions among the top 20.

The top 10 citations of articles analysed

According to total citation numbers, the top 10 most cited articles are presented in Table 4. In the top 10 most frequently cited articles, nerve block procedures were technically guided primarily by ultrasound, with the occasional use of nerve stimulators. Most of the research content of these articles focuses on the analgesia and treatment of chronic neuralgia after limb surgery, which is a large part of multi-modal

analgesia. Nerve blocks associated with the serratus anterior block are popular research topics, demonstrating that it is widely accepted as an alternative method for postoperative analgesia after chest wall surgery. In addition, the second article focused on postoperative analgesia of the knee and hip joints, indicating that nerve block is still one of the most important methods of postoperative analgesia after limb surgery. The third most popular article was a study of analgesia and complications after orthopaedic surgery with continuous nerve block.

Keywords and research trends

Keywords that appeared more than 20 times in each article were analysed using VOSviewer. This study found that by combining words with the same meaning and removing meaningless words, these keywords could be divided into five clusters, mainly including the research fields shown in Figure 6. VOSviewer coloured the settlements according to the chronological order of keywords and research hotspots, with earlier settlements represented in blue and recent settlements represented in yellow. The first cluster focused on the association between nerve block and anaesthesia or analgesia. The second cluster focused on local anaesthetic drugs for nerve block. The third cluster dealt with nerve block techniques, such as ultrasound guidance or nerve stimulation. The fourth cluster focused on postoperative analgesia for clinical procedures related to nerve block. The fifth cluster dealt with nerve block for oral local anaesthesia.

Keywords such as liposomal bupivacaine (cluster 3, APY of 2016.98), adductor canal block (cluster 3, APY of 2018.45), and pain management (cluster 3, APY of 2017.46) have emerged recently, whereas surgery (cluster 3, APY of 2014.28) was the major topic during the earlier. In addition, perineural dexmedetomidine (cluster 4, APY of 2017.25) and dexmedetomidine (cluster 4, APY of 2017.57) were the two newest words in cluster 4. Of note, the most recent words in the management-related research cluster indicate the trend in future studies.

Discussion

Development and trends in nerve block

In 1885, American scientist Halsted presented the concept of nerve block by injecting cocaine into the region surrounding nerves in the field of oral surgery (8). By the 1950s, Pearson (9) and Sarnoff (10) located motor nerves by electrical stimulation with an insulated needle and pioneered the use of nerve stimulators for nerve blocks. With the further development of medical science, nerve blocks guided by nerve stimulators are gradually being replaced by ultrasound-guided nerve blocks. Ultrasound guidance can enhance the efficacy of local anaesthetics and reduce associated complications (11, 12). Furthermore, there is a wide range of drugs available, from a single local anaesthetic to a combination of multiple drugs for nerve block. The most commonly used drug for nerve block has been constantly updated from lidocaine in the past to ropivacaine now (13). Nerve blocks can reduce the use of analgesics and facilitate postoperative pain management (14). In recent years, the development of anaesthesia management with nerve block surgery includes prostate puncture (15) and surgical

analgesia, including head, neck, and maxillofacial surgery analgesia (16), and postoperative analgesia for total hip and total knee replacement (17). The erector spinae plane block is an emerging regional anaesthetic technique with significant potential for clinical use, such as analgesia in breast surgery (18). Suprascapular nerve block is combined with axillary nerve block for arthroscopic shoulder surgery (19). Peripheral nerve block is also an ideal analgesic method during ambulatory surgery (20). Recently, nerve block not only is used in daytime surgery but also in analgesia in emergency surgery, such as the fascia iliaca compartment block relieving hip fracture pain (17). Adjuvant pharmaceuticals have been shown to prolong the duration of local anaesthetic for PNB. Research findings provide evidence for the consideration of dexmedetomidine (13), dexamethasone (21), and clonidine (22) as adjuvants to prolong PNB duration. Reversible nerve block can be achieved within a non-destructive temperature range.

Currently, nerve block has become an alternative option for postoperative multi-modal analgesia and some forms of chronic pain treatment (2, 3, 23). Based on the current number of published nerve block articles, the overall research trend has been increasing from 1990 to the present. In 1997, there were only 73 publications worldwide, but between 2010 and 2015, the number increased from under 200 to 400. By 2020, the number of articles on nerve blocks has increased to nearly 800, and according to the prediction made using regression statistics, the number of articles on nerve block will exceed 1000 by 2023, indicating that nerve block remains an important area of anaesthesia and pain research.

The United States still has the most related publications among the developed countries, followed by China, India, and other developing countries. Other developed countries, such as Canada, Britain, France, Germany, and Japan, also have several research articles on nerve block. A large number of clinical and basic studies have an economic basis, which may be the reason why developed countries significantly contribute to nerve block research. However, the number of studies in China and other developing countries is also increasing due to their increasing population and clinical needs. Based on the VOS chart, there are stronger cooperative relations between neighbouring countries, such as France–Belgium–Netherlands. In addition, there are settlements associated with South Korea, Singapore, and Turkey; and India, Thailand, and Iran, among other countries.

The journals that published more than 100 articles are basically anaesthesiology journals, such as *Regional Anesthesia & Pain Medicine*, *Anesthesia & Analgesia*, *British Journal of Anaesthesia*, *Anesthesiology*, and *Acta Anaesthesiologica Scandinavica*. This indicates that nerve block is the main field of anaesthesiology research. Notably, among the journals with more than 100 articles published, the *Journal of Endodontics* is also included. Therefore, from the perspective of treatment, nerve block has been increasingly used in oral therapy for assisted analgesia in recent years. In addition, a number of articles have been published in the *Journal of Arthroplasty*, illustrating the increasing use of nerve blocks in perioperative analgesia for extremity surgery.

Regarding the organisations publishing the articles, the top 10 basic research institutes are located in the United States, in addition to the University of Toronto in Canada and the University of Copenhagen in Denmark. Among the top 11th to 20th institutions, Birmingham Women's Hospital and the University of

London in the UK focused on nerve block research. Research institutions representing developing countries, led by Egyptian think tanks, have also contributed to the field of nerve block. In terms of the top 20 authors publishing articles, the United States still has the majority of authors publishing articles, and other countries, such as Italy, Canada, Denmark, France, and Austria, also have a large number of authors publishing articles. Liu J from China has published 24 related papers. This provides a new impetus for the research and promotion of nerve block in developing countries.

Among the top 10 most cited articles, the first was the study of a new method for ultrasound-guided nerve block in the chest wall (24), and seven of the articles were related to nerve block for limb surgery or pain (three articles were related to knee or hip surgeries, two were related to lower limb nerve blocks, and three were related to brachial plexus block and ischaemic nerve block in the forearm). The other two articles were mainly about the improvement of B-ultrasound guidance technology and the exploration of abdominal plane block after cholecystectomy for postoperative analgesia. In summary, we believe that the current focus of researchers on nerve block is mainly on the postoperative analgesia for limb surgery and the treatment of pain caused by other factors. In addition, researchers are constantly attempting to apply nerve block techniques in various aspects of postoperative analgesia, and the effect has been confirmed.

As shown in Figures 6A and B, using VOSviewer settlement analysis and trend analysis of the keywords, the study of nerve block has the following five aspects: nerve block anaesthesia, nerve block, nerve block and ultrasonic technology, nerve block analgesia (especially limb surgery), and all types of surgery with oral and maxillofacial nerve block therapy and drugs. From the perspective of increasing trends in the current research on nerve block, the injection of dexmedetomidine around the nerve has recently become the focus of many studies. In other words, dexmedetomidine (13, 25, 26) has become a new target drug for nerve block in recent years. In terms of postoperative pain management, adductor canal block and local infiltration analgesia may be a good method for postoperative analgesia in lower extremity surgery.

By searching bibliometric articles, we found only two similar bibliometric articles, one describing regional anaesthesia (27) and the other describing epidural anaesthesia (28). The emphases and concerns of the two articles are different from those of ours. Through the quantitative analysis of nerve block literature, our study aims to understand the emphases and hotspots of current national and institutional studies on nerve block and their correlation. In addition, this study also focused on the development trend of nerve block in the future. The following areas require further research: the use of new auxiliary drugs for nerves containing dexmedetomidine and local nerve blocks in oral therapy.

Our study had some limitations. First, only the WOS database was used in our study, therefore, the data retrieval may have been incomplete. Future studies should include the PubMed and Scopus databases as well. Second, regarding the definition of keywords, nerve block includes central nerve block and PNB. Although the literature on these two parts is included in our search results, it seems more reasonable to measure the literature of central nerve block separately in future studies.

Conclusions

This study summarized and analysed articles related to nerve block from 1997 to 2021. The United States still contributes the most studies, and developing countries led by China are also encouraging study in this area. The exploration of new drugs in the field of nerve block, multi-modal analgesia after surgery, treatment of chronic pain, analgesia for thoracic and abdominal surgeries, and analgesic interventions in oral therapy will all become research trends in the future.

Declarations

Conflicts of interest:

None

Funding sources:

None

Data availability:

The data used and/or analysed in our study are available from the corresponding author on reasonable request.

Author contributions:

Conceptualization, Jie Chen and Hui Zhao; Data curation, Xiang Dong and Pengcheng Zhao; Methodology, Xiang Dong and Hui Zhao; Project administration, Jinxing Liu and Pengcheng Zhao; Software, Xiang Dong; Supervision, Jinxing Liu; Writing-original draft, Xiang Dong; Writing-review & editing, Jie Chen. All authors read and approved the final manuscript.

Acknowledgements:

The authors would like to thank the Department of Anesthesiology, Ninth People's Hospital, Shanghai JiaoTong University School of Medicine for the help and support in the preparation of the manuscript and research studies.

References

1. Watson L. X. Abolishing Pain after Operations With Nerve Block a Distance. *Annals of surgery*. 1913;57(5):730-2.
2. Miller S, Lagrata S, Matharu M. Multiple cranial nerve blocks for the transitional treatment of chronic headaches. *Cephalalgia*. 2019;39(12):1488-99.

3. Goncalves Morais I, Barreira Martins A. Erector spinae plane block for chronic low back pain analgesia: A case series. *Revista espanola de anestesiologia y reanimacion*. 2021;68(7):414-9.
4. Forouzan A, Masoumi K, Motamed H, Gousheh SMR, Rohani A. Nerve Stimulator versus Ultrasound-Guided Femoral Nerve Block; a Randomized Clinical Trial. *Emergency*. 2017;5(1).
5. Rothe C, Steen-Hansen C, Madsen MH, Lange KHW. A novel concept for continuous peripheral nerve blocks. Presentation of a new ultrasound-guided device. *Acta Anaesthesiol Scand*. 2015;59(2):232-7.
6. Peterson MK, Millar FA, Sheppard DG. Editorial I - Ultrasound-guided nerve blocks. *Br J Anaesth*. 2002;88(5):621-U1.
7. Sato K, Adachi T, Shirai N, Naoi N. Continuous Versus Single-Injection Sciatic Nerve Block Added to Continuous Femoral Nerve Block for Analgesia After Total Knee Arthroplasty A Prospective, Randomized, Double-Blind Study. *Regional Anesthesia and Pain Medicine*. 2014;39(3):225-9.
8. Ingle JI. William Halsted, surgeon, pioneer in oral nerve block injection, and victim of drug experimentation. *Journal of the American Dental Association* (1939). 1971;82(1):46-7
9. Pearson RB. Nerve block in rehabilitation: a technic of needle localization. *Arch Phys Med Rehabil*. 1955;36(10):631-3.
10. Sarmoff Sj. Functional Localization of Interspinal Catheters. *Anesthesiology*. 1950;11(5):2.
11. la Grange P, Foster PA, Pretorius LK. Application of the Doppler ultrasound bloodflow detector in supraclavicular brachial plexus block. *Br J Anaesth*. 1978;50(9):965-7.
12. Montero Matamala A, Vidal Lopez F, Aguilar Sanchez JL, Donoso Bach L. Percutaneous anterior approach to the coeliac plexus using ultrasound. *Br J Anaesth*. 1989;62(6):637-40.
13. Denault AY, Roberts M, Cios T, Malhotra A, Paquin SC, Tan S, et al. The Facilitatory Effects of Adjuvant Pharmaceuticals to Prolong the Duration of Local Anesthetic for Peripheral Nerve Block: A Systematic Review and Network Meta-analysis. *Anesth Analg*. 2021;133(3):630-47.
14. Andrea Rigamonti MMG, Kan Ma, Charmagne Crescini, Nikhil Mistry, Kevin Thorge, Michael D Cusimano, Sunit Das, Gregory M T Hare, C David Mazer, . Effect of bilateral scalp nerve blocks on postoperative pain and discharge times in patients undergoing supratentorial craniotomy and general anesthesia: a randomized-controlled trial. *Can J Anesth*. 2019;67:9.
15. Borghesi M, Ahmed H, Nam R, Schaeffer E, Schiavina R, Taneja S, et al. Complications After Systematic, Random, and Image-guided Prostate Biopsy. *European Urology*. 2017;71(3):353-65.

16. Wang Y-H, Wang D-R, Liu J-Y, Pan J. Local anesthesia in oral and maxillofacial surgery: A review of current opinion. *Journal of Dental Sciences*. 2021;16(4):1055-65.
17. Garip L, Balocco AL, Van Boxtael S. From emergency department to operating room: interventional analgesia techniques for hip fractures. *Curr Opin Anesthesiol*. 2021;34(5):641-7.
18. Chin KJ, El-Boghdadly K. Mechanisms of action of the erector spinae plane (ESP) block: a narrative review. *Canadian Journal of Anesthesia-Journal Canadien D Anesthesie*. 2021;68(3):387-408. doi: 10.1007/s12630-020-01875-2.
19. Zhao J, Xu N, Li J, Liang G, Zeng L, Luo M, et al. Efficacy and safety of suprascapular nerve block combined with axillary nerve block for arthroscopic shoulder surgery: A systematic review and meta-analysis of randomized controlled trials. *International journal of surgery (London, England)*. 2021;94:106111.
20. Klein SM, Evans H, Nielsen KC, Tucker MS, Warner DS, Steele SM. Peripheral nerve block techniques for ambulatory surgery. *Anesth Analg*. 2005;101(6):1663-76.
21. Mann J, Davis K, Bright M, White L. Intravenous dexamethasone to augment peripheral nerve block efficacy: A pooled analysis of infective complications. *J Clin Anesth*. 2021;75.
22. Visoiu M, Scholz S, Malek MM, Carullo PC. The addition of clonidine to ropivacaine in rectus sheath nerve blocks for pediatric patients undergoing laparoscopic appendectomy: A double blinded randomized prospective study. *J Clin Anesth*. 2021;71.
23. Marchetti G, Vittori A, Ferrari F, Francia E, Mascilini I, Petrucci E, et al. Incidence of Acute and Chronic Post-Thoracotomy Pain in Pediatric Patients. *Children-Basel*. 2021;8(8).
24. Blanco R, Parras T, McDonnell JG, Prats-Galino A. Serratus plane block: a novel ultrasound-guided thoracic wall nerve block. *Anaesthesia*. 2013;68(11):1107-13.
25. Hussain N, Brummett CM, Brull R, Alghothani Y, Moran K, Sawyer T, et al. Efficacy of perineural versus intravenous dexmedetomidine as a peripheral nerve block adjunct: a systematic review. *Regional Anesthesia and Pain Medicine*. 2021;46(8):704-12.
26. Menshawi MA, Fahim HM. Dexmedetomidine as an adjuvant to bupivacaine in ultrasound-guided serratus anterior plane block in patients undergoing video-assisted thoracoscopic surgeries. *Ain Shams Journal of Anesthesiology*. 2021;13(1).
27. Kayir S, Kisa A. The evolution of the regional anesthesia: a holistic investigation of global outputs with bibliometric analysis between 1980-2019. *Korean Journal of Pain*. 2020;34(1):82-93.
28. Fathi M, Joudi M, Habibi G, Javid S, Mardani A, Aghasizadeh M. A Bibliometric Study of Epidural Anesthesia: A 24-year Review. *Kuwait Medical Journal*. 2015;47(2):118-21.

Tables

Table 1 TOP 20 journals with most publications in the field.

Journal	Publication Amount	Citations	Average Citations
REGIONAL ANESTHESIA AND PAIN MEDICINE	399	11,945	29.94
ANESTHESIA AND ANALGESIA	301	11,025	36.63
BRITISH JOURNAL OF ANAESTHESIA	133	5,710	42.93
ANESTHESIOLOGY	128	7,540	58.91
ACTA ANAESTHESIOLOGICA SCANDINAVICA	108	2,383	22.06
JOURNAL OF ENDODONTICS	100	2,795	27.95
JOURNAL OF CLINICAL ANESTHESIA	89	1,226	13.78
ANAESTHESIA	88	2,566	29.16
EUROPEAN JOURNAL OF ANAESTHESIOLOGY	87	1,845	21.21
PAIN MEDICINE	82	1,322	16.12
VETERINARY ANAESTHESIA AND ANALGESIA	78	918	11.77
JOURNAL OF ARTHROPLASTY	77	1,685	21.88
PAIN PHYSICIAN	75	1,240	16.53
BMC ANESTHESIOLOGY	68	365	5.37
PEDIATRIC ANESTHESIA	68	1,248	18.35
MEDICINE	66	349	5.29
JOURNAL OF ANESTHESIA	61	452	7.41
JOURNAL OF PAIN RESEARCH	57	276	4.84
MINERVA ANESTESIOLOGICA	53	342	6.45
CUREUS	47	79	1.68

Table 2 Distribution of the top 20 institutes publishing research in the field.

Institution	Records	%
HARVARD UNIVERSITY	195	3.029
UNIVERSITY OF CALIFORNIA SYSTEM	170	2.641
UNIVERSITY OF TORONTO	144	2.237
UNIVERSITY OF COPENHAGEN	113	1.755
PENNSYLVANIA COMMON WEALTH SYSTEM OF HIGHER EDUCATION (PCSHE)	111	1.724
UNIVERSITY OF PITTSBURGH	91	1.414
MAYO CLINIC	89	1.383
STANFORD UNIVERSITY	89	1.383
OHIO STATE UNIVERSITY	86	1.336
BRIGHAM WOMEN'S HOSPITAL	81	1.258
US DEPARTMENT OF VETERANS AFFAIRS VETERANS HEALTH ADMINISTRATION [VHA]	79	1.227
UNIVERSITY OF TEXAS SYSTEM	78	1.212
CLEVELAND CLINIC FOUNDATION	77	1.196
UNIVERSITY HEALTH NETWORK TORONTO	73	1.134
UNIVERSITY OF CALIFORNIA SAN DIEGO	70	1.087
UNIVERSITY OF LONDON	70	1.087
BOSTON CHILDREN S HOSPITAL	68	1.056
CORNELL UNIVERSITY	67	1.041
EGYPTIAN KNOWLEDGE BANK [EKB]	64	0.994
HARVARD MEDICAL SCHOOL	64	0.994

Table 3 Distribution of the top 20 authors publishing research in the field.

Author	Country	Publication Amount
Mariano ER	USA	57
Reader A	USA	56
Beck M	USA	54
Ilfeld BM	USA	54
Nusstein J	USA	44
Drum M	USA	39
Fanelli G	Italy	34
Casati A	Italy	33
Kohane DS	USA	33
Hadzic A	USA	31
Brull R	Canada	30
Bendtsen TF	Denmark	29
Capdevila X	France	29
Borglum J	Denmark	28
Chelly JE	USA	24
Liu J	Peoples R China	24
Marhofer P	Austria	24
Dahl JB	Denmark	23
Gerner P	USA	23
Memtsoudis SG	USA	23

Table 4 Top 10 publications with the most citations in the field

Title	Corresponding Authors	Country	Journal	Publication Year	Total Citations
Serratus plane block: a novel ultrasound-guided thoracic wall nerve block	R. Blanco	England	Anaesthesia	2013	404
Local infiltration analgesia: a technique for the control of acute postoperative pain following knee and hip surgery	Kerr, Dennis R	Australia	ACTA ORTHOPAEDICA	2008	378
Continuous peripheral nerve blocks in hospital wards after orthopedic surgery - A multicenter prospective analysis of the quality of postoperative analgesia and complications in 1,416 patients	Capdevila, X	France	ANESTHESIOLOGY	2005	318
Modulation of plasticity in human motor cortex after forearm ischemic nerve block	Ziemann, U	USA	JOURNAL OF NEUROSCIENCE	1998	294
Nerve stimulator and multiple injection technique for upper and lower limb blockade: Failure rate, patient acceptance, and neurologic complications	Casati, A	Italy	ANESTHESIA AND ANALGESIA	1999	290
A multimodal analgesia protocol for total knee arthroplasty - A randomized, controlled study	Vendittoli, PA	Canada	JOURNAL OF BONE AND JOINT SURGERY	2006	283
Periradicular infiltration for sciatica - A randomized controlled trial	Karppinen, J	Finland	SPINE	2001	278
Ultrasound-guided	Marhofer, P	Austria	BRITISH JOURNAL	2009	263

transversus abdominis plane block: description of a new technique and comparison with conventional systemic analgesia during laparoscopic cholecystectomy			OF ANAESTHESIA		
Ultrasonographic guidance improves sensory block and onset time of three-in-one blocks	Marhofer, P	Austria	ANESTHESIA AND ANALGESIA	1997	260
Ultrasound guidance improves success rate of axillary brachial plexus block	Chan, VWS	Canada	CANADIAN JOURNAL OF ANAESTHESIA	2007	248

Figures

Figure 1

Flow diagram of the inclusion process. Detailed searching and screening process.

Figure 2

Distribution of the top 20 countries which published research in the field.

Figure 3

Mapping of the countries with publications on nerve block.

Figure 4

Fitting curves of cumulative publications and growth trends.

Distribution of the top 20 journals which published research in the field.

Analysis of keywords in publications on nerve block. (A) Mapping of the keywords in the field. (B) Distribution of keywords on the basis of the average publication year.