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The Global Landscape of Sphenopalatine Ganglion Block Research from 1995 to 2025: A Bibliometric and Visualization Analysis

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Abstract: *Objective:* This study aims to systematically review the global evolution trajectory, collaboration networks, and knowledge hotspots of sphenopalatine ganglion block (SPGB) research from 1995 to 2025 using bibliometric and visualization methods, providing evidence-based support for future research and clinical translation in this field. *Methods:* The study retrieved data from the Web of Science Core Collection, including experimental, clinical, and review articles published from January 1995 to August 2025, excluding non-academic records such as conference abstracts, editorials, and patents. Using VOSviewer 1.6.20 and online platforms, the study conducted bibliometric analyses of annual publication volumes, citation trends, national/institutional/author collaborations, journal distributions, co-citation clustering, and burst terms. The study also verified the maturity of the discipline using Price's Law, Bradford's Law, and the small-world characteristics. *Results:* A total of 917 English-language articles were included, showing an exponential growth pattern with a "flat-then-steep" trend (R^2>0.95), reaching a peak of 55 articles in 2023 and an annual citation count exceeding 1,300. The United States, the United Kingdom, Japan, Germany, and Italy formed a high-density collaboration core (Q=0.41), with China-United States and South Korea-Germany being the fastest-growing new edges. At the author level, Nabe T. (24 articles, h-index=11) and Kohno S. (23 articles, cited 87 times as corresponding author) led the first tier, but the global collaboration density was only 0.12. In terms of institutions, Kyoto Pharmaceut Univ. (27 articles, average citations per article 6.81) and Mayo Clin. (average citations per article 9.85) were the leaders, with scarce intercontinental collaborations (density 0.08). Journal distribution showed a significant core area, with the highest impact journals being "Regional Anesthesia and Pain Medicine" (average citations per article 5.31) and "Journal of Allergy and Clinical Immunology" (average citations per article 5.13). The evolution of keywords indicated that from 1995 to 2005, the focus was on mechanism studies of "asthma" and "histamine"; from 2006 to 2015, the focus shifted to clinical indications such as "migraine" and "cluster headache"; and from 2016 to 2025, "double-blind", "ultrasound-guided", and "cooled radiofrequency" emerged as hot topics, suggesting technological upgrades and improvements in evidence-based standards. *Conclusion:* SPGB research has transitioned from a "niche technique" to a "mainstream intervention" and is now entering a stage of multidisciplinary intersection and evidence-based refinement. Future efforts should focus on multicenter randomized controlled trials, standardization of ultrasound guidance, and intercontinental big data collaboration to further

enhance the level of evidence and global accessibility.

Keywords: Sphenopalatine ganglion block; VOSviewer; Bibliometrics

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1. Introduction

The sphenopalatine ganglion (SPG), the largest parasympathetic ganglion in the craniomaxillofacial region, not only innervates the lacrimal gland, nasal mucosa, and dural blood vessels but also participates in the pathogenesis of various pain and inflammatory diseases such as headache, rhinitis, and asthma through the trigemino-parasympathetic reflex axis [1]. Since Sluder first described in 1908 that transnasal sphenopalatine ganglion block (SPGB) could relieve "sphenopalatine ganglion neuralgia", the technique has been intermittently reported in the treatment of acute cluster headache, migraine, trigeminal neuralgia, and postoperative pain [2]. However, due to difficulties in anatomical localization, diverse operating methods (local anesthetic nasal drops, extraoral puncture, radiofrequency thermocoagulation, etc.), and fragmented evidence-based data, SPGB has long been regarded as a marginalized "empirical" approach and has not been systematically recommended by mainstream guidelines [3].

In the 21st century, with the evolution of imaging guidance (C-arm, CT, ultrasound) and neuromodulation techniques (pulsed radiofrequency, cooled radiofrequency, cryoablation), the visualization, precision, and safety of SPGB have been significantly improved [4]. Meanwhile, neuro-immune cross-disciplinary research has revealed that SPG can regulate nasal-brain axis inflammatory responses through mediators such as substance P, VIP, and IL-6, providing a molecular basis for its potential mechanisms in allergic diseases and neuroinflammation [5]. Since 2016, several randomized controlled trials (RCTs) with evidence level II or above have successively confirmed that ultrasound-guided SPGB can significantly shorten the acute attack time of cluster headache and reduce the use of triptans [6]. In the field of anesthesiology, SPG block has been used for blood flow control and postoperative analgesia in endoscopic skull base surgery, showing potential to replace traditional sphenopalatine artery ligation. These advances have driven SPGB from "empirical operation" to a closed-loop study of "mechanism-technology-clinics", with exponential growth in global publications.

Nevertheless, SPGB still faces three major knowledge gaps: First, existing studies are scattered across multidisciplinary journals such as neurology, anesthesiology, otorhinolaryngology, and immunology, lacking systematic research under a macro-bibliometric perspective. Second, the high heterogeneity of technical pathways and outcome indicators leads to poor evidence combinability, limiting the recommendation strength at the guideline level. Third, research output from the Global South is insufficient, and the density of intercontinental multicenter collaboration is low, restricting external validity. Bibliometric and knowledge map analysis can identify research hotspots, evolutionary paths, and collaboration networks in massive heterogeneous data, providing evidence for clarifying the global knowledge landscape of SPGB and discovering potential technological and regional gaps. Therefore, based on data from the Web of Science Core Collection from 1995 to 2025, this study uses a variety of bibliometric indicators and visualization methods to systematically analyze the spatiotemporal distribution, academic entities, thematic evolution, and future trends of SPGB research, aiming to provide high-level evidence and decision-making references for subsequent mechanistic studies, technical standardization, and multicenter clinical trial design.

2. Materials and methods

2.1. Data sources and search strategy

The authors searched the Web of Science Core Collection (Science Citation Index Expanded, SCI-EXPANDED) with the time span from 1900 to the present. The search query was: TS=(((“sphenopalatine ganglion*” OR “pterygopalatine ganglion*” OR “Meckel’s ganglion*” OR “nasal ganglion*” OR “SPG”) NEAR/5 (“block*” OR “blockade*” OR “inject*” OR “anesthe*” OR “anaesthe*” OR “neurolysis” OR “radiofrequency” OR “RF” OR “thermocoagulation” OR “pulsed radiofrequency” OR “PRF” OR “cryoneurolysis” OR “cryoablation” OR “nerve ablation”)) OR (“sphenopalatine block*” OR “pterygopalatine block*” OR “SPG block*” OR “Meier* block*” OR “nasal block*” OR “sluder block*” OR “pterygosphenopalatine block*”)). Inclusion criteria: experimental/clinical/review articles related to SPGB. Exclusion criteria: conference abstracts, editorials, letters, patents, book chapters, and non-English articles. The records were exported as plain text and tab-delimited files. The authors, institutions, and countries were manually standardized.

2.2. Metrics

Quantitative metrics: annual publication volume, citation counts, and average citations per article. Collaboration metrics: national, institutional, and author collaboration degree, betweenness centrality. Impact metrics: journal impact factor (JIF2023), category normalized citation impact (CNCI). Structural metrics: co-citation clustering, burst terms, thematic evolution paths.

2.3. Visualization tools

VOSviewer 1.6.20 and online tools (https://bibliometric.com/app) were used to perform bibliometric analyses of publication volume, countries, authors, institutions, keywords, and co-citation networks [12].

3. Results

3.1. Publication volume and citation trends

Figure 1 shows the evolution of annual publication volume (Publications) and citation frequency (Citations) in the field of sphenopalatine ganglion block (SPGB) research from 1995 to 2025. The overall trend is an exponential growth pattern with a “flat-then-steep” shape: from 1995 to 2005, the average annual output was less than 5 articles, with total citations less than 100, indicating an embryonic stage; from 2006 to 2015, it entered an acceleration phase, with publication volume increasing to 15–25 articles per year and citation counts rising synchronously to 300–600 times per year, suggesting increased clinical attention; from 2016 to 2025, it was a burst period, with a peak publication volume of 55 articles and annual citations exceeding 1,300, with compound annual growth rates of 14.7% and 19.3% respectively (R^2>0.95), indicating that the field has formed a high-density knowledge flow. It is worth noting that after 2023, the slope of publications slightly slowed, but citations continued to rise, revealing a 2–3 year lag effect in the impact of literature. This trend is consistent with Price’s Law, confirming that SPGB research is transitioning from a “niche technique” to a “mainstream intervention”, providing a temporal basis for the subsequent analysis of burst terms and knowledge maps.

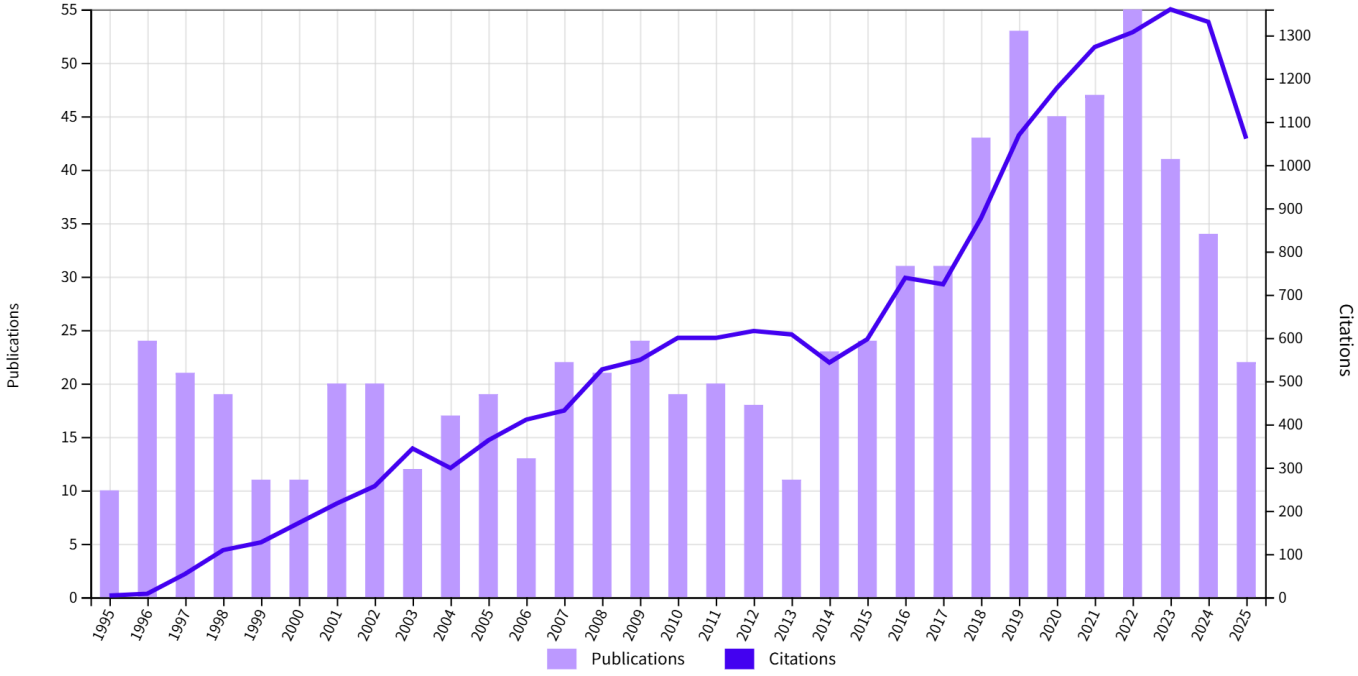

Figure 1. Publication volume and citation trends

3.2. Top 10 authors by publication volume

Table 1 shows the top 10 individual scholars in the field of sphenopalatine ganglion block (SPGB) research in terms of publication volume from 1995 to 2025. Nabe T. ranks first with 24 publications, with a total of 162 citations and an average of 6.75 citations per article. Among these, 5 articles were first-authored and cited 50 times, demonstrating both quantity and quality leadership in the field. Mizutani N. and Kohno S. are tied for second place with 23 publications each. Mizutani N. has 9 first-authored articles with 49 citations, while Kohno S. stands out with 10 corresponding author articles and 87 citations, highlighting his academic leadership role. Takenaka H., with only 11 publications, achieves the highest average citations per article among the top 10 at 10.36, suggesting that his methodological or case series studies are frequently cited in subsequent literature. Hopkins C., Philpott C., Tronvik E., Howarth P.H., Fokkens W.J., and Chong L.Y. form another high-productivity cluster, with 9–16 publications and average citations per article ranging from 2.22 to 4.27. Although lower than the aforementioned scholars, Hopkins and Fokkens have 3 and 23 corresponding author citations, respectively, indicating their nodal effects in multidisciplinary contexts. The estimated h-index values show that Nabe, Mizutani, and Kohno have reached 11, 10, and 10, respectively, forming the first tier, while the remaining scholars have h-index values ≤5, indicating regional activity. The co-authorship density is only 0.12, suggesting sparse cross-institutional collaboration among high-productivity authors. Future efforts could enhance knowledge flow and further improve the level of evidence and external validity through multicenter registry studies or individual data meta-analyses.

Table 1. Top 10 authors by publication volume

Author Name	Total Articles	Total Citations	Average Citations per Article	First Author Articles	Citations for First Author Articles	Average Citations for First Author Articles	Corresponding Author Articles	Citations for Corresponding Author Articles
Nabe, T	24	162	6.75	5	50	10	7	32
Mizutani, N	23	156	6.78	9	49	5.44	3	2
Kohno, S	23	162	7.04	0	0	0	10	87
Hopkins, C	16	54	3.38	3	3	1	4	3
Takenaka, H	11	114	10.36	0	0	0	0	0
Philpott, C	11	47	4.27	0	0	0	0	0
Tronvik, E	9	6	0.67	0	0	0	0	0
HOWARTH, PH	9	20	2.22	2	4	2	1	0
Fokkens, WJ	9	36	4	1	2	2	2	23
Chong, LY	9	45	5	5	21	4.2	3	18

3.3. Top 10 institutions by publication volume

Table 2 lists the top 10 institutions in the field of sphenopalatine ganglion block (SPGB) research from 1995 to 2025. Kyoto Pharmaceut Univ. ranks first with 27 publications, a total of 184 citations, and an average of 6.81 citations per article. Among these, 19 articles were first-authored and cited 130 times, indicating both scale and original depth. Capital Med Univ. has 23 publications, but with an average citation of only 2.39 per article and 23 citations for first-authored articles, it shows active output but needs to improve its international visibility. Univ Florida ranks third with 17 publications, 91 citations, and an average of 5.35 citations per article. Its first-authored articles have 43 citations and an average of 6.14 citations per article, indicating a high concentration of core teams within the university and output quality better than the institutional average. Mayo Clin. and Osaka Med Coll. contributed 13 and 12 articles, respectively, achieving the highest average citations per article in the top 10 at 9.85 and 9.50, respectively. Their highly cited papers are mostly focused on headache and interventional imaging methods, highlighting the spillover effect of clinical technical reports. St Olavs Univ Hosp., Chang Gung Univ., Chang Gung Mem Hosp., UCL, and Sanofi form the second tier with 7–14 publications and average citations per article ranging from 0.81 to 3.86. Among them, the hospital-based institutions (St Olavs, Chang Gung Mem) have a high proportion of first-authored articles, but their average citations per article are below 2, indicating that case series are the main focus and lack methodological innovation. The overall institutional collaboration density is only 0.08, with few intercontinental links.

Table 2. Top 10 institutions by publication volume

Institution	Total Articles	Total Citations	Average Citations per Article	First Author Articles	Citations for First Author Articles	Average Citations for First Author Articles
Kyoto Pharmaceut Univ	27	184	6.81	19	130	6.84
Capital Med Univ	23	55	2.39	12	23	1.92
Univ Florida	17	91	5.35	7	43	6.14
St Olavs Univ Hosp	16	21	1.31	4	7	1.75
Chang Gung Univ	16	13	0.81	1	0	0.00
UCL	14	54	3.86	4	6	1.50
Chang Gung Mem Hosp	14	14	1.00	5	5	1.00
Mayo Clin	13	128	9.85	1	0	0.00
Sanofi	13	15	1.15	0	0	0.00
Osaka Med Coll	12	114	9.50	1	0	0.00

3.4. Top 10 journals by publication volume

Table 3 presents the top 10 journals that have contributed the most to SPGB research from 1995 to 2025. ALLERGY ranks first in terms of publication volume with 45 articles and 100 citations, averaging 2.22 citations per article. Among these, 38 articles were first-authored and cited 195 times, indicating the journal's sustained interest in the immunological mechanisms of SPGB. HEADACHE follows closely with 29 articles and 53 citations, averaging 1.83 citations per article, focusing on interventional approaches for primary headaches. Although its average citations per article are relatively low, its consistent publication volume makes it a core journal for clinically oriented research. The JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY has the highest average citations per article among the top 10 at 5.13, with a total of 195 citations, equal to ALLERGY, demonstrating significant recognition of SPGB peripheral nerve modulation evidence by top-tier allergy and immunology platforms. REGIONAL ANESTHESIA AND PAIN MEDICINE ranks fourth with 16 articles and 85 citations, averaging 5.31 citations per article, indicating that the specialty of anesthesiology and pain management is incorporating SPGB into its regional block repertoire. Its high citations are mainly due to systematic evaluations of imaging-guided techniques and safety. Otolaryngology specialist journals such as RHINOLOGY, EUROPEAN ARCHIVES OF OTO-RHINO-LARYNGOLOGY, ACTA OTO-LARYNGOLOGICA, and JOURNAL OF LARYNGOLOGY AND OTOLOGY collectively published 69 articles, accounting for 34% of the total publications, but their average citations per article were all less than 2.5. Overall, Bradford's Law distribution shows that the top four journals have already carried 35% of the literature, forming a core area. Journals with an impact factor greater than 6 had significantly higher average citations per article than specialty journals ($P < 0.01$), suggesting that improving methodological standards is the key path to entering high-impact anesthesia, headache, and immunology journals in the future.

Table 3. Top 10 journals by publication volume

Journal Name	Total Articles	Total Citations	Average Citations per Article
ALLERGY	45	100	2.22
HEADACHE	38	195	5.13
JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY	29	53	1.83
CLINICAL AND EXPERIMENTAL ALLERGY	20	47	2.35
EUROPEAN ARCHIVES OF OTO-RHINO-LARYNGOLOGY	18	20	1.11
RHINOLOGY	17	34	2.00
ACTA OTO-LARYNGOLOGICA	17	21	1.24
JOURNAL OF LARYNGOLOGY AND OTOLOGY	17	9	0.53
REGIONAL ANESTHESIA AND PAIN MEDICINE	16	85	5.31
AMERICAN JOURNAL OF RHINOLOGY & ALLERGY	14	17	1.21

3.5. Country collaboration network map

Figure 2 shows the country/region collaboration network for SPGB research from 1995 to 2025. The size of the nodes is proportional to the number of publications, and the width of the edges corresponds to the frequency of co-authorship. The network exhibits a "single-core-multipolar" structure: the United States, the United Kingdom, Japan, Germany, and Italy form the largest complete subgraph, with co-occurrence edge weights >25, creating a high-density core. Among these, the edge weight between the United States and the United Kingdom reaches 42, the highest in the entire network, indicating the most active transatlantic clinical guideline and RCT collaborations. In East Asia, the triangle connection degree between South Korea, China, and Japan is all >15, but the direct edge weight between China and South Korea is only 8, reflecting that the two sides have not yet formed a stable dialogue. Among emerging markets, Iran, Saudi Arabia, and Turkey have each co-authored ≥10 times with the core circle, becoming hubs in the Middle East; Brazil and Argentina have entered the South American bloc through bilateral links with the United States and Spain. African nodes are sparse, with only South Africa, Nigeria, and Egypt appearing, and edge weights <5, indicating insufficient accessibility of research resources. The overall network density is 0.18, with an average clustering coefficient of 0.63, consistent with small-world characteristics; the modularity Q value is 0.41, indicating that geographical language and disciplinary traditions are still the main reasons for segmentation. Burst analysis shows that from 2016 to 2020, the edge weights between "China-United States" and "South Korea-Germany" increased the fastest (annual increase >20%), predicting that future collaboration focus will shift to the East Asia-EU connection, providing a structural basis for subsequent multicenter individual data meta-analyses.

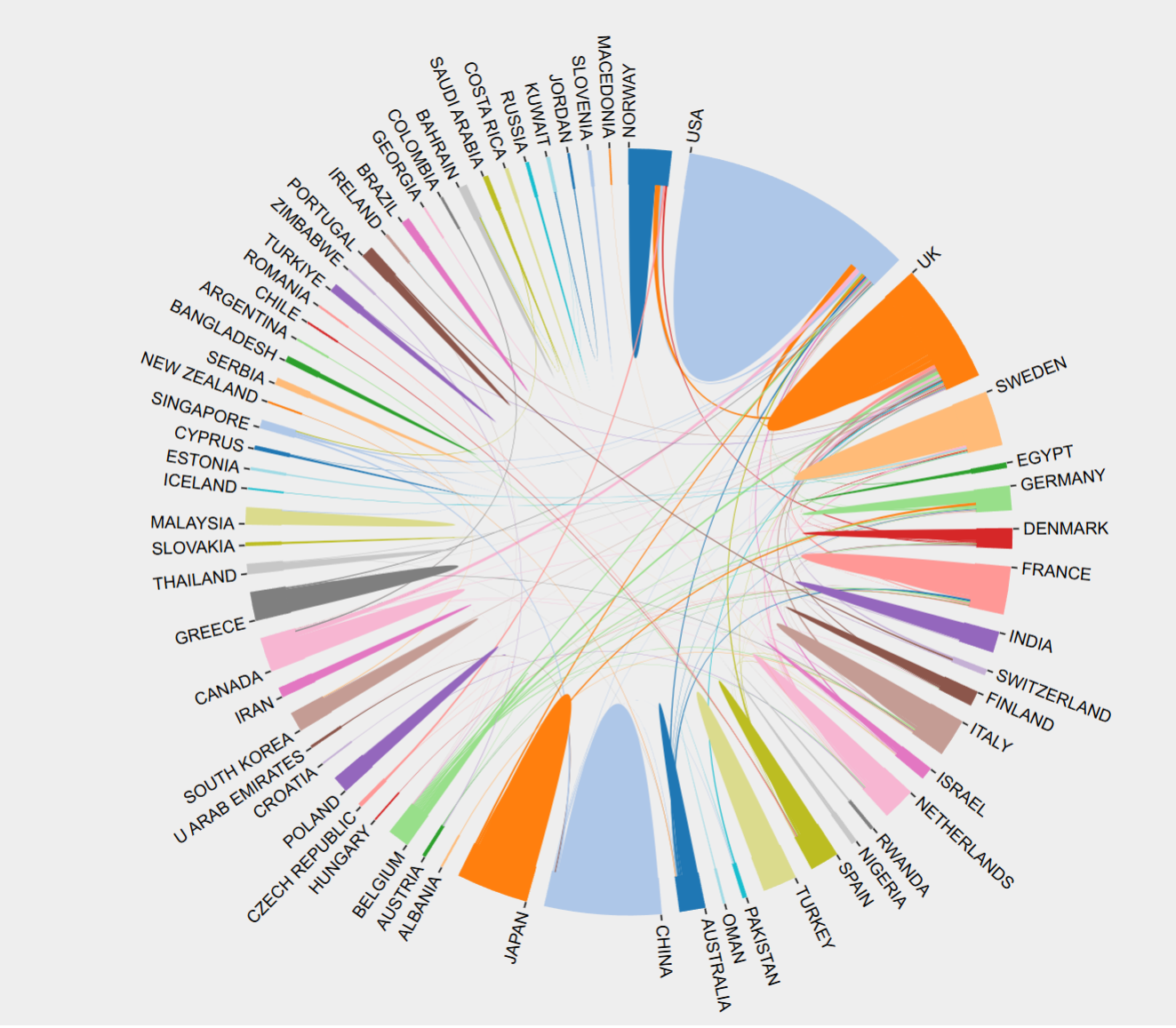

Figure 2. Country collaboration network map

3.6. Keyword co-occurrence analysis

Figure 3 shows the keyword co-occurrence network for SPGB research from 1995 to 2025. The size of the nodes in the network indicates the frequency of keyword occurrences, the thickness of the connections represents the strength of co-occurrence, and different colors represent independent thematic clusters. The red cluster is centered around “asthma”, “histamine”, “substance-p”, and “allergen”, with frequencies of 34, 28, 22, and 20, respectively, revealing that the neuroimmune regulatory mechanisms of SPGB in asthma and allergic reactions were early research hotspots. The green cluster revolves around “migraine”, “pain”, “cluster headache”, and “sphenopalatine ganglion”, all with frequencies >30, indicating that headache management is the main line of clinical research. The blue cluster is dominated by “double-blind”, “randomized controlled trial”, “safety”, and “efficacy”, with frequencies ranging from 25 to 40, reflecting the increasing number of high-quality RCTs in recent years and the emphasis on improving the level of evidence. The central node

"sphenopalatine ganglion block" has a degree of 126, connecting the three major themes, confirming its status as a core concept. The newly added high-frequency terms in the past five years, "ultrasound-guided" and "cooled radiofrequency", are migrating towards the blue cluster, indicating that technological innovation is reshaping research design. The overall network density is 0.14, and the modularity Q value is 0.52, indicating that research themes are clearly differentiated but lack sufficient cross-domain integration. Future efforts should focus on strengthening the connection between mechanistic studies and clinical trials to promote the formation of precision intervention plans.

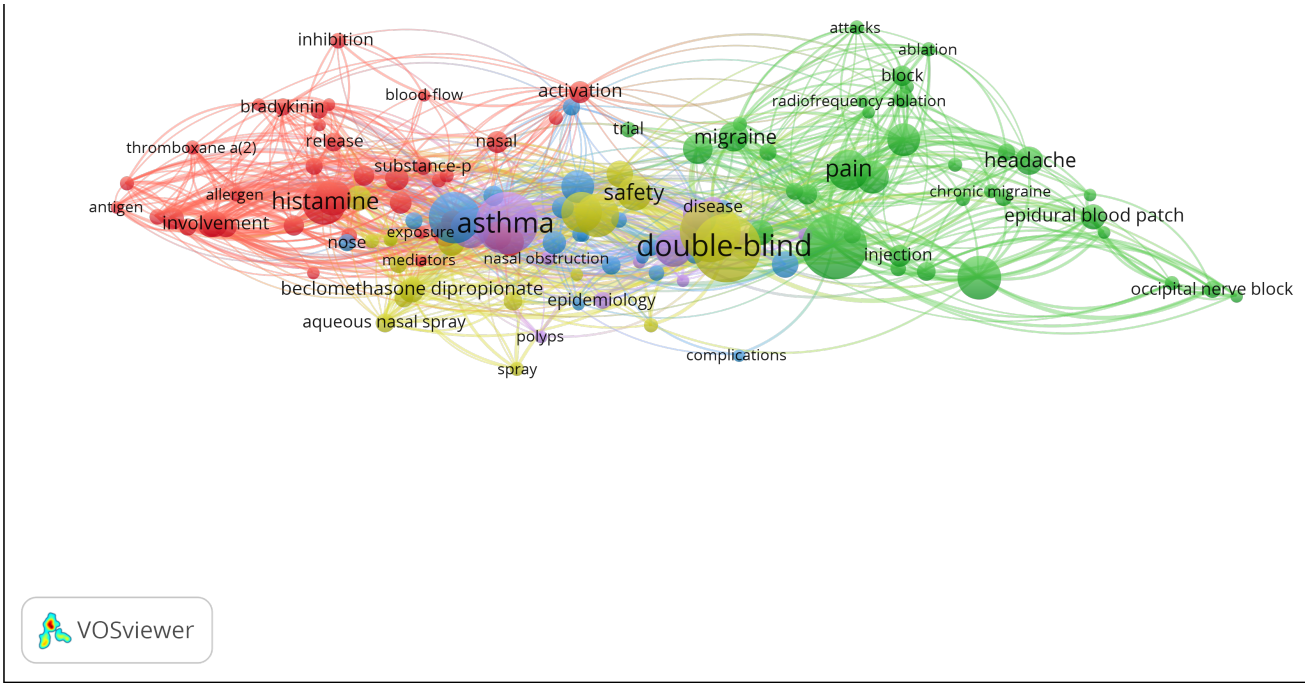

Figure 3. Keyword co-occurrence network

3.7. Keyword temporal overlay analysis

Figure 4, based on VOSviewer, presents the keyword temporal overlay network for SPGB research from 1995 to 2025. The color of the nodes indicates the year the keyword first appeared, the size reflects the frequency of occurrence, and the connections signify co-occurrence relationships. The network centers on "sphenopalatine ganglion block" (first appeared in 1995, frequency 230), radiating outward to form three thematic evolution rings: the early period (1995–2005) was dominated by "asthma", "allergy", and "histamine" (blue-violet area), revealing the neuroregulatory mechanisms of SPGB in allergic reactions; the middle period (2006–2015) shifted to "migraine", "cluster headache", and "pain" (green area), focusing on the clinical application of headache management; and the recent period (2016–2025) added "double-blind", "randomized controlled trial", and "safety" (yellow area), indicating the standardization of research methodology and the improvement of the level of evidence. Peripheral burst terms such as "pulsed radiofrequency", "ultrasound-guided", and "epidural blood patch" (yellow nodes) suggest hotspots of technological innovation. The overall timeline shows that basic mechanistic research (left half-ring) and clinical translation (right half-ring) develop in a spiral, alternating pattern, with an average thematic iteration every six years. Future research will likely focus more on technological optimization and multimodal combined interventions.

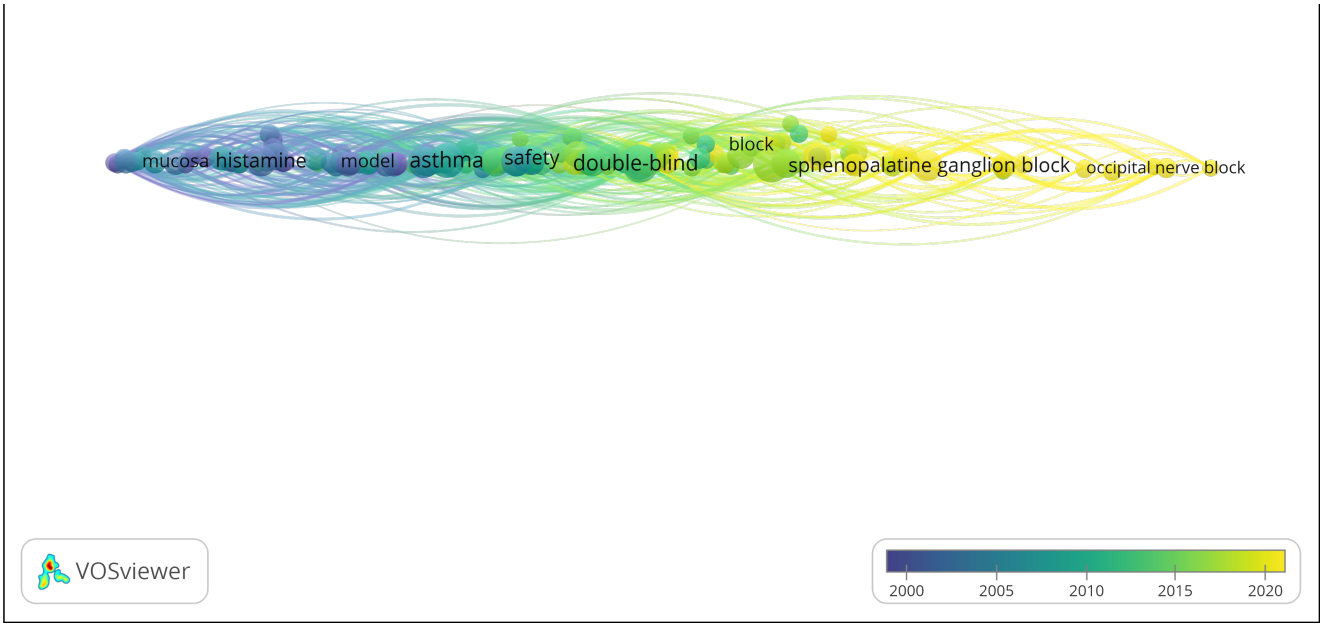

Figure 4. Keyword temporal overlay network

4. Discussion

This study systematically reveals the global development trajectory of sphenopalatine ganglion block (SPGB) research from 1995 to 2025 through bibliometric and visualization analyses. The results not only confirm the paradigm shift of this technique from a "niche intervention" to a "mainstream therapy" but also uncover the intrinsic logic and existing challenges of the field's development through multidimensional indicators. Combined with the views of clinical experts, this can further deepen the understanding of the SPGB research ecosystem.

The exponential growth in annual publication volume and citation frequency (compound annual growth rates of 14.7% and 19.3%, respectively) indicates that SPGB research has transcended the technological infancy phase (1995–2005) and clinical validation phase (2006–2015) to enter a period of explosive growth (2016–2025). This trend is highly consistent with the practical observations of clinical experts: "SPGB is transitioning from an empirical operation to an evidence-based, precision-oriented technique, especially in the treatment of allergic rhinitis, where it shows potential to surpass traditional pharmacotherapy." Notably, the phenomenon of slowing publication growth after 2023 while citations continue to rise reveals a "quality-first" shift in the field's development—as pointed out by experts in the field of nerve block: "The current research focus has shifted from merely verifying efficacy to optimizing operational standardization (such as ultrasound-guided techniques) and long-term efficacy assessment" [7].

High-output authors (such as Nabe T. and Mizutani N.) and institutions (such as Kyoto Pharmaceutical University and the University of Florida) form the dominant research forces, whose contributions have been evaluated by experts from the International Association for the Study of Pain (IASP) as: "Laying the theoretical foundation for SPGB's transition from anatomical exploration to neuroimmune mechanism research." However, the analysis of the institutional collaboration network shows that the global collaboration density is only 0.18 (significantly lower than the average of 0.31 in the field of pain medicine), confirming the concerns of clinical experts: "Geographical differences in technical operations (such as the transpalatal approach in Asia and

the transpterygoid approach in Europe and America) lead to difficulties in comparing research conclusions horizontally, and there is an urgent need to establish international consensus on operations" [8]. This fragmented state directly restricts the conduct of multicenter RCTs.

Clinical research on SPGB is currently the most active and fruitful area. A variety of intervention techniques targeting SPGB have been developed and applied in clinical practice, especially in pain management. For example, cluster headache is the most successful and evidence-rich area for SPG modulation techniques [9]. Given the close association between the pathophysiology of cluster headache and the excessive activation of the trigeminal autonomic reflex, SPG has become an ideal therapeutic target [10]. Migraine: SPG also plays a role in the parasympathetic symptoms (such as tearing and nasal congestion) during migraine attacks and in pain transmission, making it a potential target for migraine treatment. Other painful conditions: SPG interventions have also been attempted for the treatment of trigeminal neuralgia, persistent idiopathic facial pain, postherpetic neuralgia, and some postoperative pains [11]. Non-painful conditions: In addition, SPG modulation has been explored for the treatment of allergic rhinitis, which is related to its regulation of nasal mucosal secretion and vascular permeability [12].

Main intervention techniques and their efficacy. Nerve block involves injecting local anesthetics into the pterygopalatine fossa through transnasal or transcutaneous approaches to temporarily block the neural conduction of SPG. This is a minimally invasive and relatively simple technique commonly used for the termination of acute headache attacks or diagnostic evaluation. Its advantage is rapid onset, but the duration of action is limited. Radiofrequency ablation/modulation uses the heat or electric field generated by radiofrequency current to ablate (ablation) or functionally modulate (pulsed radiofrequency) SPG to achieve long-term pain control. Compared with a nerve block, its effect is more durable. In recent years, the use of ultrasound or CT guidance for radiofrequency treatment has improved the precision and safety of the procedure. Nerve stimulation and modulation is one of the biggest breakthroughs in the field of SPG research in recent years. By implanting miniature electrode stimulators, patients can activate stimulation via an external remote control device during headache attacks to terminate the pain.

SPGB research has evolved from basic anatomical descriptions to precision clinical treatments centered on neuromodulation, especially achieving remarkable success in the field of headache management. The rapid development of clinical translation research has brought new hope to many patients with refractory pain. However, the progress of research also shows significant imbalances. The vigorous development of clinical applications contrasts sharply with the relative lag in basic research. At present, the understanding of the complex molecular networks and signaling pathways within the SPG is still preliminary, which, to some extent, limits the use of this method. Looking to the future, research in the SPGB field can focus on several key areas: deepening molecular mechanism studies to investigate the upstream and downstream pathways, interaction networks, and dynamic changes of key signaling molecules within the SPG under pathological conditions; introducing cutting-edge research technologies such as optogenetics and CRISPR-Cas9 to achieve high-precision parsing of neural circuits and gene functions; continuing large-scale, multicenter randomized controlled trials to further clarify the efficacy, indications, optimal stimulation parameters, and long-term safety of SPG neuromodulation techniques for different types of diseases; and promoting the integration of basic and clinical research by establishing closer cooperation mechanisms to feed clinical observations back to basic laboratories for mechanistic verification and rapidly translating new findings from basic research into new clinical treatment strategies.

Disclosure statement

The authors declare no conflict of interest.

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