

Visualization Analysis of Transversus Abdominis Plane Block in Abdominal Surgery Based on Bibliometrics

Transversus Abdominis Plan Bloğunun Abdominal Cerrahide Bibliyometrik Temelli Görselleştirme Analizi

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ABSTRACT

Background: Acute pain following surgery is common and constitutes a significant healthcare priority because of its potential impact on quality of life. The use of transversus abdominal plane block (TAP-B) has emerged as a current approach to alleviate postoperative pain. This study was designed to (a) assess the scientific trends in the use of TAP-B and (b) determine the trend toward the decision to use TAP-B, especially when central neuraxial blocks are technically difficult or contraindicated.

Materials and Methods: This study examines TAP-B research from a bibliometric perspective. As of June 12, 2023, the literature related to TAP-B published in the last two decades (2003-2023) was retrieved from the Web of Science Core Collection database. The keywords “transversus abdominis plane” and “abdominal” were used for the search strategy. Data analysis and visualizations were conducted using VOSviewer 1.6.0.

Results: A total of 546 studies were examined, with the year 2021 (n=1491) receiving the highest number of citations and 2022 (n=56) being the most productive year in terms of publications. The first publication in 2007, authored by McDonnell JG. from Ireland, had the highest publication frequency (n=9) and citations (n=498).

Conclusion: Studies in the literature indicate an increasing trend in the use of TAP-B for postoperative pain management after lower abdominal surgery, which emphasizes its efficacy. The TAP block is emerging as a cornerstone in postoperative multimodal analgesia in cases where central nerve blocks are contraindicated or technically difficult, especially where central neuraxial blocks are contraindicated or technically difficult.

Keywords: Postoperative pain, transversus abdominis plane block, anesthesia, abdominal surgery, bibliometrics

ÖZ

Amaç: Alt karın cerrahisini takiben akut postoperatif ağrı yaygın bir endişe kaynağıdır. Transversus abdominis plan bloğunun (TAP-B) kullanımı, postoperatif ağrıyı hafifletmek için güncel bir yaklaşım olarak ortaya çıkmıştır. Bu çalışma (a) TAP-B'nin kullanımı konusunda bilimsel eğilimleri değerlendirmek ve (b) özellikle santral nöroaksiyel blokların teknik olarak zor veya kontrendike olduğu durumlarda, TAP-B'nin kullanım kararına yönelik eğilimi belirlemek amacıyla planlandı.

Gereç ve Yöntemler: Bu çalışma, TAP-B araştırma çıktılarının genel bir bakışını sunmak amacıyla bibliyometrik bir perspektiften incelenmiştir. 12 Haziran 2023 itibarıyla, son yirmi yılda (2003-2023) yayınlanan TAP-B ile ilgili literatür Web of Science Core Collection veri tabanından alınmıştır. Arama strateji olarak “transversus abdominis plane” ve “abdominal” anahtar kelimeleri kullanıldı. Veri analizi ve görsellikler VOSviewer 1.6.0 kullanılarak gerçekleştirilmiştir.

Bulgular: Toplam 546 çalışma incelenmiş olup, 2021 yılı (n=1491) en çok atıf alan ve 2022 yılı (n=56) yayın açısından en üretken yıl olmuştur. İlk yayın 2007 yılında, en yüksek yayın sıklığı (n=9) ve atıf (n=498) ile İrlanda'dan McDonnell JG tarafından yapılmıştır.

Sonuç: Bu konuda literatürde yer alan araştırmalar, TAP-B'nin alt karın cerrahisi sonrası postoperatif ağrı yönetiminde etkinliğini vurgulayarak kullanımında artan bir eğilimi işaret etmektedir. Santral sinir bloklarının kontrendike olduğu veya teknik olarak zor olduğu durumlarda, TAP bloğu postoperatif multimodal analjezide, özellikle santral nöroaksiyel blokların kontrendike olduğu veya teknik olarak zor olduğu durumlarda, postoperatif multimodal analjezide bir köşe taşı olarak ortaya çıkmaktadır.

Anahtar Kelimeler: Postoperatif ağrı, transversus abdominis plan blok, anestezi, abdominal cerrahi, bibliyometri



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Introduction

Acute postoperative pain following abdominal surgery, a prevalent medical procedure, has become a recurrent concern in recent times. It can adversely affect various organs and tissues, impede postoperative recovery, and lead to significant morbidity and mortality. Effective postoperative pain management coupled with early postoperative mobilization enhances quality of life and reduces the incidence of morbidity and mortality. Consequently, the control of postoperative pain is of paramount importance (1,2,3). Postoperative pain management encompasses a spectrum of techniques, including the administration of pharmacological agents, patient-controlled analgesia using morphine, epidural pain relief, intravenous pain relief, intrathecal pain relief administration, local anesthetic infiltration, and the application of regional nerve blocks (4).

Transversus abdominis plane block (TAP-B), a peripheral nerve block, is extensively used for postoperative analgesia. A local anesthetic is introduced into the space between the internal oblique and transversus abdominis muscles, effectively blocking the nerves within the abdominal wall. TAP-B demonstrates efficacy in providing analgesia, which diminishes the postoperative stress response and expedites postoperative recovery (4,5,6).

This study explored TAP-B research from a bibliometric perspective to provide an overview of the research outputs in this field. Bibliometric analysis serves as a compass for navigating the literature and pinpointing precise research directions. From the inception of the first publication on the TAP-B technique in abdominal surgery in 2007 to 2023, our study conducted a comprehensive statistical and visual analysis. This study was designed to (a) assess the scientific trends in the use of TAP-B and (b) determine the trend toward the decision to use TAP-B, especially when central neuraxial blocks are technically difficult or contraindicated. We aim to provide insights that not only reflect the current state but also anticipate future developments by scrutinizing influential research papers, contemporary topics, and emerging trends during this period.

Materials and Methods

Study Design and Participants

Data were extracted from an online dataset for this descriptive bibliography study. Participants were not directly involved in the study.

Database and Search Strategy

On June 12, 2023, researchers extracted TAP-B literature from the Web of Science Core Collection (WoSCC) database published during the past two decades (between 2003 and 2023). The search strategy was based on Boolean operators and the potential keywords “transversus abdominis plane” (all fields) AND “abdominal” (all fields). The 546 studies found at the end of the search strategy were analyzed according to publication trends, numerical values, citation frequencies, countries, institutions, authors, keywords, and average number of citations (Figure 1).

Ethics committee approval was not required because this was a bibliometric study. Not required as this was a bibliometric study.

Research Methods

Fundamental data from the literature, gathered through WoSCC, were exported and systematically documented to enhance comprehension of the prospective applications of TAP-B technology in abdominal surgery.

Statistical Analysis

In this study, academic papers were analyzed using statistical techniques such as frequency count, percentage, average, and mode. This analysis unveiled the current status and trends in research within this domain and to pinpoint priorities and orientations for future studies. The data underwent thorough analysis and visualization using VOSviewer 1.6.0, Microsoft Excel, and WoSCC report.

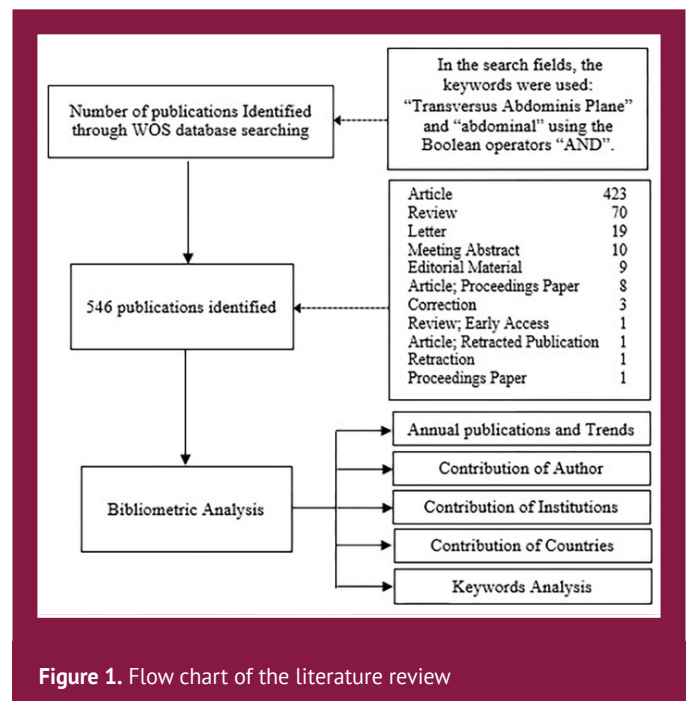


Figure 1. Flow chart of the literature review



Results

There are 546 studies on the use of TAP-B technology in abdominal surgery published between 2003 and 2023. The first study on this topic was published in 2007. The cumulative times cited amount to 11,887, with an average of 21.77 per item and an h-index of 52. The primary focus of these studies was on parameters such as total opioid dose, acetaminophen use, duration of pain relief, and patient satisfaction within the initial 24 hours post-surgery. Secondary objectives included determining the opioid quantity administered over 24 h, pain intensity, occurrences of nausea and vomiting, clinical ileus rate, time to flatulence, and duration of hospitalization.

The peak number of citations occurred in 2021 (citations: 1491, publications: 45), whereas the highest number of publications was observed in 2022 (citations: 1371, publications: 56). The most cited publication (n=498) was published in 2007 in Anesthesia and Analgesia (Journal Citation Indicator 1.95 and Q1). The frequency of published studies exhibited a fluctuating pattern and gradually increased over time. The h-index reached its zenith in 2012. TAP-B in abdominal surgery has garnered increasing attention recently (Figure 2).

Bibliometric Analysis of the Authors of the Studies

The research on TAP-B studies in abdominal surgery involved the ranking of author collaboration networks, identifying key authors, and major collaboration networks in the field using visualization software. McDonnell JG

emerged as the first-named author of the most cited paper and holds the record for the highest number of publications, with a total of nine papers, three of which list him as the primary author. Furthermore, the study, which involved a maximum of 16 authors, was published in 2019 and received 19 citations (7).

A total of 2367 different authors contributed to the subject. By grouping them, 92 authors were identified, forming five main author groups. While there are connections between the groups, most connections are observed between the main groups (Figure 3).

TAP-B has been a focal point of academic research in the field of abdominal surgery, leading to the emergence of numerous certified professionals and researchers during the past 16 years. The inaugural study on the subject was published in 2007 and investigated the effectiveness of painkillers in patients undergoing abdominal surgery within the first 24 h. This randomized, controlled, double-blind study reported a reduction in visual analog scale measurement at postoperative time points, decreased morphine requirements in the first 24 hours postoperatively, absence of complications attributable to TAP-B, and provision of highly effective postoperative analgesia in the initial 24 hours after major abdominal surgery. This study laid the foundation for subsequent research with 498 citations (7). According to a network analysis of authors' collaboration status, studies on TAP-B applications in abdominal surgery generally involve "relatively concentrated investigators with strong academic affiliations and recognition".

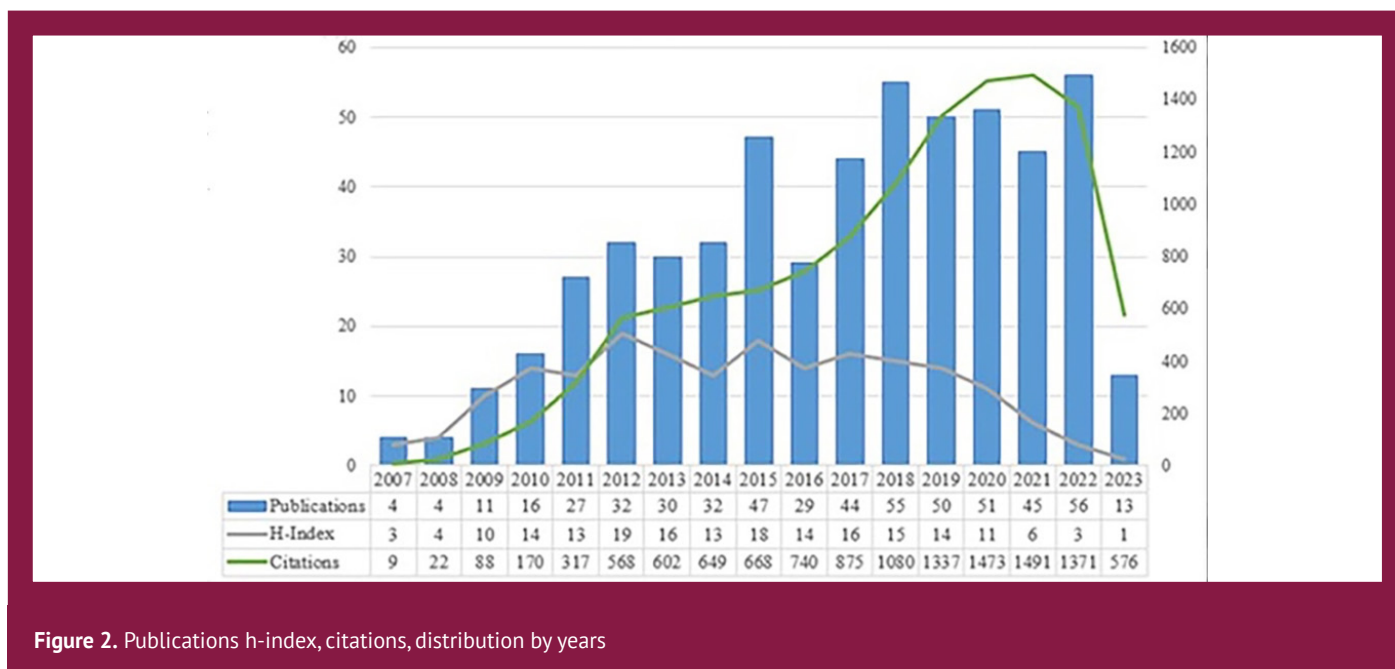


Figure 2. Publications h-index, citations, distribution by years

Bibliometric Analysis of Research Institutions and Countries

Research institutions are considered to play a significant role in scientific research. There are currently 15 research institutes divided into three main clusters according to the data provided by the author's institution (Figure 4a). The scientific knowledge map of institutional collaboration demonstrates a high degree of inter-institutional collaboration.

Our analysis revealed that 23 countries contributed to the three main topics with ≥ 5 publications (Figure 4b). The USA (n=122) is the global leader in this field, followed by India (n=59), and China (n=53) follows. Other notable contributors include the United Kingdom, Egypt,

Türkiye, and Canada. The connection among clusters is strong, suggesting international collaboration in TAP-B implementation in abdominal surgery. Interestingly, the most cited article originated from Ireland, highlighting the potential for geographically diverse contributions to impactful research in this domain. Moreover, our analysis revealed specific differences in the research focus and contributions of the world's leading countries within TAP-B research for abdominal surgery.

Centrality analysis suggests that the United States plays a pivotal role in research collaboration, having the most common co-publications with other countries exceeding five publications. India leads with 31% of collaborations during studies examining the combined use of adjuvants

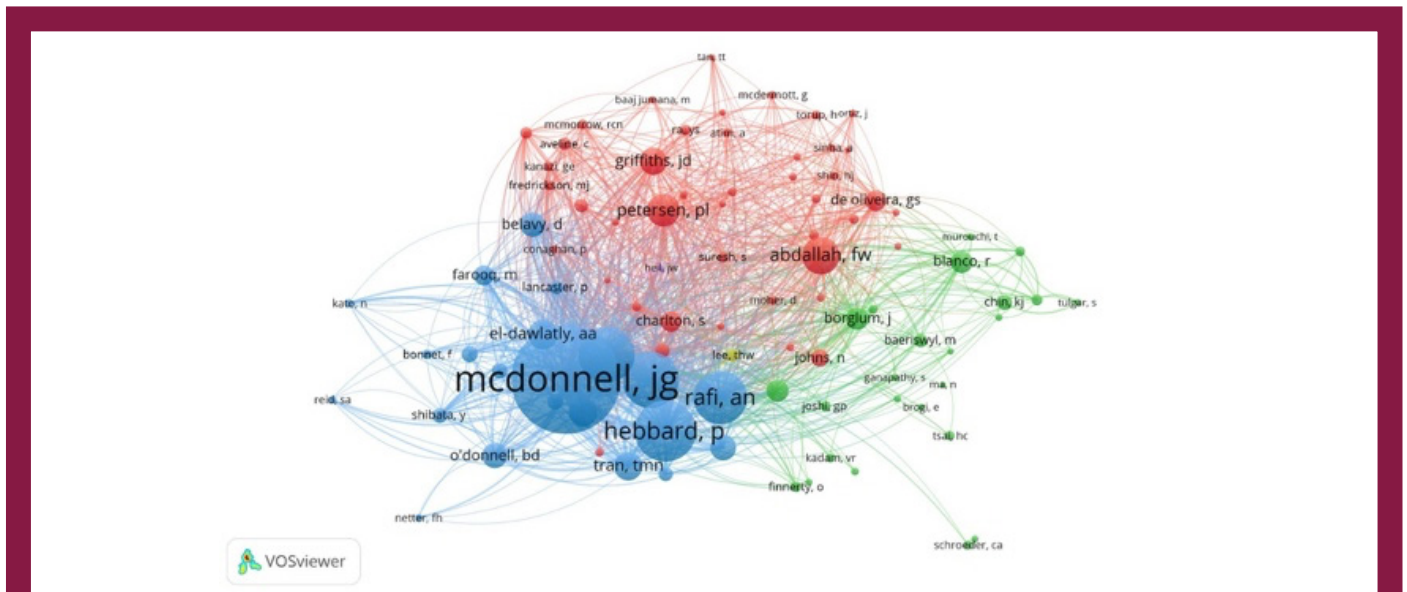


Figure 3. Bibliometric visualization of co-citations/cited authors

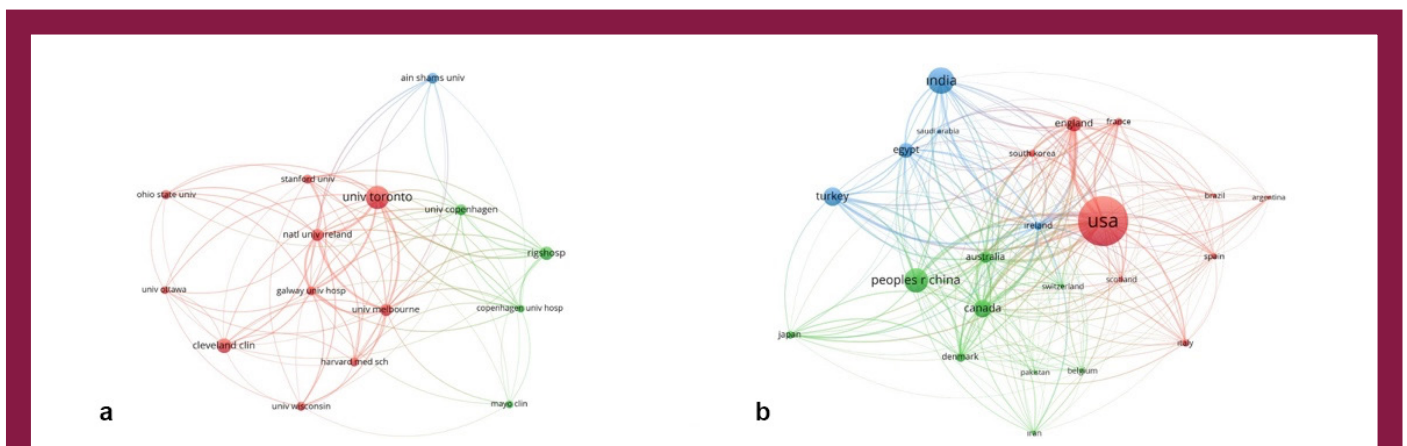


Figure 4. a) Bibliometric visualization of Institutions; b) bibliometric visualization of countries

Table 1. Analysis of author, journal, keyword, and citation of the 10 most cited studies

Authors	Source title	Quarter	Impact factor	Keywords plus	Times cited	Publication year
McDonnell et al. (7)	Anesthesia and Analgesia	Q1	1.95	Pain	498	2007
McDonnell et al. (9)	Anesthesia and Analgesia	Q1	1.95	Anesthesia, surgery, section, opioids	391	2008
Carney et al. (10)	Anesthesia and Analgesia	Q1	1.95	Randomized controlled trial, efficacy, delivery, surgery	298	2008
Chin et al. (11)	Regional Anesthesia and Pain Medicine	Q2	1.91	Randomized controlled trial, quadratus lumborum block, postoperative pain, gastric bypass, bupivacaine	241	2017
Belavy et al. (12)	British Journal of Anesthesia	Q1	2.63	Randomized controlled trial, efficacy	221	2009
Tran et al. (13)	British Journal of Anesthesia	Q1	2.63	Randomized controlled trial, analgesic efficacy, tap block	210	2009
Rozen et al. (14)	Clinical Anatomy	Q2	1.08	Epigastric perforator flap, free trap flap, plane block, breast reconstruction, sensory recovery, muscle, sensibility, analgesia, anatomy	207	2008
McDonnell et al. (15)	Regional Anesthesia and Pain Medicine	Q2	1.91	Postoperative pain treatment, analgesia, surgery	199	2007
Charlton et al. (16)	Cochrane Database of Systematic Reviews	Q1	1.33	Rectus sheath block, postoperative analgesia, pain, efficacy	191	2010
Niraj et al. (17)	British Journal of Anesthesia	Q1	2.63	Surgery, pain	190	2009

featuring the most cited study (498 citations) concerning the implementation of TAP-Bs in abdominal surgery. The cumulative number of studies published in this journal is 26. The top 10 journals enumerated in Table 1 are categorized as either “Q1” or “Q2” following the Journal of Clinical Research 2019 standards.

Discussion

Postoperative pain is a significant concern for both patients and clinicians, and globally, inadequate management of postoperative pain persists as a prevalent clinical challenge (18). Various approaches exist for postoperative pain management, including the use of morphine, epidural analgesia, intramuscular and intravenous pain relief, intrathecal analgesia, local anesthetics, and nerve blocks. Among these approaches, the TAP-B was initially described in 1993 and formally documented in 2001 (3,4,19). TAP-B has been recognized as a successful adjunctive procedure for postoperative analgesia, albeit with potential complications such as block failure, abdominal organ injury, nerve injury, and vascular injury (20,21,22). Fortunately, the application of ultrasound facilitates visualizing the injection point, the plane of touch, and the needle, leading to improved

accuracy in ultrasound-guided punctures and a reduction in associated complications (23). Numerous comprehensive studies and reference books have delved into the detailed application of ultrasound-guided techniques, particularly in the abdomen and subcostal region (24,25).

The TAP block reduces the need for postoperative opioid use, provides superior analgesia for up to 48 h, and prolongs the time to first request for further analgesia. Moreover, it provides more effective pain relief and significantly reduces opioid-related side effects and perioperative opioid consumption. In addition, USG-guided administration ensures precise placement of the TAP-B local anesthetic and minimizes complications (8,26,27,28).

The transversus abdominis plane (TAP) block demonstrated a notable enhancement in both early and late pain scores, resulting in a decreased use of postoperative opioids within the initial 24 hours. It has been associated with a shorter ambulation time and a reduced incidence of postoperative nausea and vomiting additionally (29).

In Hafeman et al. (30), TAP block offers analgesia following pediatric procedures for a longer period than caudal block. It is also linked to a lower analgesic dosage during the first 24 hours without increasing pain scores (21).

According to the study by Viderman et al. (31), TAP block groups had considerably reduced opioid requirements 24 hours following laparoscopic and combined types of procedures than did the 'no block' groups (22).

Effective management of postoperative pain has been linked to early mobilization, enhanced patient satisfaction, shorter hospital stays, reduced healthcare costs, and overall improved outcomes (32). In this regard, the transversus abdominis plane (TAP) block could serve as a viable alternative to epidural analgesia, considering clinically significant differences in pain intensity. Furthermore, this alternative could mitigate the rare but serious risks associated with epidural analgesia, including fatal cardiovascular collapse, meningitis, spinal cord ischemia, and vertebral canal abscess or hematoma (33).

In the last 16 years, 546 articles on the application of TAP-B in abdominal surgery were found in the WoS database, and the number of articles showed a gradual increasing trend. The most published author was J.G. McDonnell, from the Departments of Anesthesiology and Surgery, University of Galway-Ireland, who suggested that TAP block provides highly effective postoperative analgesia within the first 24 hours after major abdominal surgery.

With a bibliometric study, we can make suggestions for future research. Although TAP-B is a simple intervention, practitioners need to customize treatment strategies according to various variables (drugs, catheters, etc.). Therefore, good practice guidelines are needed. The lack of analysis of adverse events encountered during TAP-B implementation is a serious gap.

Study Limitations

Because this study is based on keywords in the WoSCC, it may not capture all research on TAP-B. In cases where more than one database is used, including the same article in the analysis more than once may affect the reliability of the results. Future software for bibliometric analyses may include interdisciplinary indicators and data sharing standards to overcome these limitations by analyzing search results from multiple databases. The fact that the database we used is one of the most popular multidisciplinary databases used scientifically was instrumental in identifying research gaps and potential areas for future research on TAP-B.

Conclusion

The potential applications of TAP-B extend beyond its established role in postoperative analgesia for various surgical procedures. The accumulated research underscores the efficacy of TAP-B in postoperative pain management following lower abdominal surgery, signifying a growing trend in its use. In addition, they are proposed for use in

conjunction with general anesthesia for chronic pain management, muscle disease diagnosis, and treatment, as well as complication prevention. TAP-B can be acknowledged as a foundational element in postoperative multimodal analgesia, particularly in situations where central neuraxial blocks are contraindicated or technically challenging.

Ethics

Ethics Committee Approval: Ethics committee approval was not required because this was a bibliometric study.

Informed Consent: Not required as this was a bibliometric study.

Authorship Contributions

Surgical and Medical Practices: E.A., H.Y., E.E., Concept: E.A., H.Y., E.E., Design: E.A., H.Y., E.E., Data Collection or Processing: E.A., H.Y., E.E., Analysis or Interpretation: E.A., H.Y., E.E., Literature Search: E.A., H.Y., E.E., Writing: E.A., H.Y., E.E.

Conflict of Interest: There are no conflicts of interest between the authors.

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