EISSN 2667-6370

Turkish Journal of Anaesthesiology & Reanimation

Volume 51 • Issue 6 • December 2023

Official journal of the TURKISH SOCIETY OF ANAESTHESIOLOGY AND REANIMATION

galenos Publishing House

turkjanaesthesiolreanim.org

Turkish Journal of Anaesthesiology & Reanimation

Turkish Journal of Anaesthesiology & Reanimation

Publisher Contact
Address: Molla Gürani Mah. Kaçamak Sk. No: 21/1
34093 İstanbul, Turkey
Phone: +90 (530) 177 30 97
E-mail: info@galenos.com.tr/yayin@galenos.com.tr
Web: www.galenos.com.tr **Publisher Certificate Number:** 14521

Publishing Date: December 2023
E-ISSN: 2667-6370
International scientific journal published bimonthly.

Turkish Journal of Anaesthesiology & Reanimation

Aims and Scope

The Turkish Journal of Anaesthesiology and Reanimation (Turk J Anaesthesiol Reanim) is the open access, online-only, and scientific publication organ of the Turkish Society of Anaesthesiology and Reanimation. The journal is published in accordance with independent, unbiased, and double-blind peer review principles. The journal is published bimonthly, in February, April, June, August, October, and December.

The publication language of the Turkish Journal of Anaesthesiology and Reanimation is English, and the journal requires UK spelling. When preparing their manuscript, authors should use British spellings throughout. However, the journal welcomes manuscripts both in Turkish and English for evaluation; however authors of articles written in Turkish are required to provide the journal with the English version of their accepted article prior to publication.

The aim of the journal is to contribute to the literature and field of anaesthesiology by publishing clinical and experimental research articles, case reports, letters to the editor, study protocols, and scientific conference proceedings that are prepared in accordance with the ethical guidelines in the fields of anaesthesiology, intensive care, and pain therapy. As of 2022, Turkish Journal of Anaesthesiology and Reanimation will not give as much priority to case reports and letters to the editor in the evaluation and publication process. Before submitting your manuscript, please take this into account.

The target audience of the journal includes specialists and medical professionals working in the fields of anaesthesiology, intensive care, and pain therapy.

The editorial and publication processes of the journal are shaped in accordance with the guidelines of the International Committee of Medical Journal Editors (ICMJE), World Association of Medical Editors (WAME), Council of Science Editors (CSE), Committee on Publication Ethics (COPE), European Association of Science Editors (EASE), and National Information Standards Organization (NISO). The journal is in conformity with the Principles of Transparency and Best Practice in Scholarly Publishing (doaj.org/bestpractice).

The Turkish Journal of Anaesthesiology and Reanimation is indexed in PubMed Central, Web of Science - Emerging Sources Citation Index, China National Knowledge Infrastructure (CNKI), TUBITAK ULAKBIM TR Index, EMBASE, Scopus, EmCare, CINAHL, ProQuest, Gale.

Processing and publication are free of charge with the journal. No fees are requested from the authors at any point throughout the evaluation and publication process. All manuscripts must be submitted via the online submission system, which is available at www.turkjanaesthesiolreanim.org. The journal guidelines, technical information, and the required forms are available on the journal's web page.

All expenses of the journal are covered by the Turkish Society of Anaesthesiology and Reanimation. Potential advertisers should contact the Editorial Office. Advertisement images are published only upon the Editor-in-Chief 's approval. Statements or opinions expressed in the manuscripts published in the journal reflect the views of the author(s) and not the opinions of the Turkish Society of Anaesthesiology and Reanimation, editors, editorial board, and/or publisher; the editors, editorial board, and publisher disclaim any responsibility or liability for such materials.

Open Access Statement

The Turkish Journal of Anaesthesiology and Reanimation is an open access publication, and the journal's publication model is based on Budapest Open Access Initiative (BOAI) declaration. All published content is available online, free of charge at https:// turkjanaesthesiolreanim.org/EN. Authors retain the copyright of their published work in The Turkish Journal of Anaesthesiology and Reanimation. The journal's content is licensed under a Creative Commons Attribution (CC BY) 4.0 International License which permits third parties to share and adapt the content for any purpose by giving the apropriate credit to the original work.

You can find the current version of the Instructions to Authors at: https:// turkjanaesthesiolreanim.org/en/instructions-to-authors- 1029.

All published content is available online, free of charge at www.turkjanaesthesiolreanim.org.

OPEN ACCESS

Chief Editor: Aslı Dönmez
Address: University of Health Sciences, Ankara Etlik City Hospital, Ankara, Turkey
E-mail: aslidonmez@hotmail.com
Web: www.turkjanaesthesiolreanim.org

Publisher: Galenos Publishing House
Address: Molla Gürani Mah. Kaçamak Sk. No: 21/1 34093 İstanbul, Turkey
Phone: +90 (530) 177 30 97
E-mail: info@galenos.com.tr/yayin@galenos.com.tr
Web: www.galenos.com.tr

Turkish Journal of Anaesthesiology & Reanimation

Contents

Review Articles

Original Articles

Turkish Journal of Anaesthesiology & Reanimation

Contents

DOI: 10.4274/TJAR.2023.231478

Review Article
Regional Anaesthesia

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):450-458

The Role of Regional Anaesthesia and Acute Pain Services in Value-Based Healthcare

Sapna Ravindranath[1], Yatish S Ranganath[1], Kevin Backfish-White[1], John Wolfe[1], Sanjib Adhikary[2]

[1]Indiana University Faculty of Medicine, Department of Anaesthesia, Indiana, USA
[2]Penn State College of Medicine, Department of Anaesthesiology and Perioperative Medicine, Pennsylvania, USA

Cite this article as: Ravindranath S, Ranganath YS, Backfish-White K, Wolfe J, Adhikary S. The Role of Regional Anaesthesia and Acute Pain Services in Value-Based Healthcare. *Turk J Anaesthesiol Reanim.* 2023;51(6):450-458.

Abstract

Value-based healthcare prioritizes patient outcomes and quality relative to costs, shifting focus from service volume to delivered value. This review explores the significant role of regional anaesthesia (RA) and acute pain services (APS) within the evolving value-based healthcare (VBHC) framework. At the heart of VBHC is the goal to enhance patient outcomes while simultaneously optimizing operational efficiency and reducing costs. The review underscores the need for VBHC and illustrates how integrating RA/APS with Enhanced Recovery Protocols can lead to improved outcomes, aligning directly with the goals of the Triple Aim. Several clinical studies show that RA improves patient outcomes, enhances operating room efficiency, and reduces costs. This is complemented by a discussion on the integration of RA and APS into the VBHC model, highlighting emerging value-based payment structures and strategies for their successful implementation. By merging specialized RA/APS protocols with standardized clinical practices, significant improvements in operating room efficiency and associated economic benefits are observed. Across the healthcare spectrum, from providers to payers, this synergy results in enhanced operational efficiency and communication, raising the standard of patient care. Additionally, the potential of RA and APS to address the opioid crisis, through alternative pain management methods, is emphasized. Globally, the shift towards VBHC requires international collaboration, sharing of best practices, and efficient resource allocation, with RA and APS playing a crucial role. In conclusion, as healthcare moves toward a value-driven model, RA and APS become increasingly essential, signaling a future of refined, patient-centered care.

Keywords: Acute pain service, operating room efficiency, opioid epidemic, perioperative outcomes, perioperative pain management, regional anaesthesia, value-based health care

Main Points

- Regional anaesthesia (RA) and acute pain services (APS) are crucial in the value-based healthcare (VBHC) framework, significantly improving patient outcomes and operational efficiency.
- Studies demonstrate that RA enhances patient recovery and operational throughput, while also reducing healthcare expenses.
- Their integration into VBHC not only improves care quality but also provides alternative pain management strategies, crucial in addressing the opioid crisis.
- As healthcare pivots to value-driven models, RA and APS emerge as key strategies, influencing both patient care and healthcare economics. Research and its practical application in this area are vital for future advancements.

Introduction

Value-based healthcare (VBHC) is a healthcare delivery model in which hospitals and physicians are compensated based on patient health outcomes, in contrast to the traditional fee-for-service model that pays for each service or procedure performed.[1,2] The "value" in VBHC is derived from measuring health outcomes against the cost of delivering the services. VBHC prioritizes patient well-being, evidence-based practices, and cost efficiency,

Corresponding author: Yatish S Ranganath, e-mail: yrangan@iu.edu

Received: November 14, 2023 Accepted: December 04, 2023

aligning with the Institute for Healthcare Improvement's Triple Aim Framework which targets improved patient experience, enhanced population health, and reduced costs.[3] As healthcare systems globally face challenges from scarce resources, escalating healthcare costs, and aging populations, there is a notable shift towards adopting VBHC to revolutionize health delivery and management. In the United States, the need for VBHC is highlighted by soaring healthcare costs, which reached $4.3 trillion in 2021, averaging $12,914 per person annually. Projections suggest this could nearly double by 2031, pushing healthcare's GDP contribution from 18.3% in 2021 to 19.6%.[4] Yet, despite such expenditures, the U.S. trails in life expectancy compared to several developed nations and faces an estimated 98,000 preventable deaths annually.[5] This discrepancy between costs and outcomes further emphasizes the urgency for VBHC.

Surgical care expenses represent a considerable segment of overall health care expenditure, with data from 2014 indicating that they accounted for as much as 51% of total Medicare spending.[6] Surgery and anaesthesiology are inextricably linked, as most surgical interventions require anaesthesia. Anaesthesiologists, in collaboration with perioperative professionals, offer specialized skills ranging from preoperative assessments to postoperative surveillance in high-value surgical care. Their unique position in hospital-based care enables them to spearhead the recalibration of perioperative processes, improving operational efficiency and clinical outcomes. Such improvements benefit patients through reduced complications and costs, while also optimizing coordination, much to the advantage of hospital administrators and insurance payors. Regional anaesthesia (RA) is a subspecialty within anaesthesiology, utilizing neuraxial blocks (e.g., spinal, or epidural blocks) and peripheral nerve blocks for surgical procedures. RA is frequently chosen for its notable advantages, such as improved post-operative recovery, better postoperative analgesia, and reduced post-operative opioid use.[7] Further, within the VBHC framework, RA in conjunction with Enhanced Recovery Pathways (ERPs) is gaining significance. Together, RA and ERPs aim to reduce complications and hospital stays and offer holistic improvements in patients' experiences, perioperative expenses, and overall health status, aligning with the Triple Aim goals of VBHC (Figure 1).[8]

In this review, we will examine the role of RA and the Acute Pain Service (APS) in enhancing patient outcomes, bolstering healthcare efficiency, and cutting costs. Additionally, we will discuss their integration into the VBHC model and the benefits they present for various stakeholders. Finally, we will address future perspectives, emphasizing research opportunities and the implications for evidence-based practice.

Role of RA and APS in Enhancing Patient Outcomes

Various RA techniques are available, including neuraxial blocks, paravertebral blocks, fascial plane blocks, and peripheral nerve blocks. A full exploration of every nerve block option for different surgical procedures is beyond the scope of this article. Nonetheless, when viewing anaesthesia care through the lens of VBHC, it becomes essential to underline the critical role, impact, and benefits of RA & APS. This article will highlight these aspects, drawing from pertinent literature and using tables to summarize the main points (Tables 1 and 2).

Summary of Studies on Patient Outcome Benefits (Table 1)

In thoracic surgeries, RA improves pulmonary function after lobectomy and reduces the risk of post-operative pulmonary complications and mortality, especially in chronic obstructive pulmonary disease patients.[9,10] RA reduces unplanned intensive care unit (ICU) admissions, the duration of mechanical ventilation, and the length of ICU stays.[11] Some studies also pointed to a potential reduction in the incidence of post thoracotomy pain syndrome.[12] In cardiac surgeries, opioids traditionally took precedence over epidurals and blocks, mainly because of anticoagulation and hemodynamic concerns. However, the emergence of fascial plane blocks is shifting this trend. Blocks targeting the erector spinae and parasternal regions have been associated with improved recovery, greater patient satisfaction, and reduced ICU length of stay, though further research is

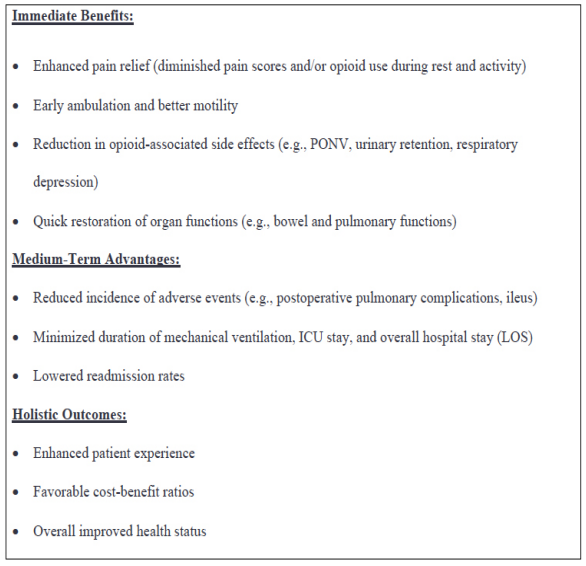

Figure 1. Enhancing healthcare value: a framework for RA/APS and ERP in the triple aim context.

RA, regional anaesthesia; APS, acute pain service; ERP, enhanced recovery pathway; PONV, postoperative nausea and vomiting; LOS, length of stay.

Table 1. RA/APS Studies: Evidence for Improved Patient Outcomes
1. Thoracic surgery
Improved post-lobectomy pulmonary function (FEV1, FVC).[9]
Reduced post-operative pulmonary complications/mortality, especially in COPD patients' post-surgery.[10]
Reduced unplanned ICU admissions after thoracotomy. Reduced ventilation duration, potentially shortened ICU/hospital stays.[11]
May reduce post thoracotomy pain syndrome incidence.[12]
2. Cardiac surgery
Opioids favored over epidurals/blocks due to anticoagulation and hemodynamic issues.
Fascial plane blocks (Erector spinae and Parasternal) boost recovery and satisfaction; reduce ICU stay.[13,14]
3. Vascular surgery
• AV Fistula/Grafts
Improved vessel patency, fewer failures, and facilitation of AVG to AVF transition post-dilation.[15]
Superior maturation and patency at 6 & 12 months.[15]
• Carotid endarterectomy
RA was found to be more cost-effective, shortened surgery duration and hospital stays.[16]
Fewer complications and lower in-hospital mortality than GA in recent studies, despite earlier equivalent findings.[17]
4. Orthopedic surgery
• Lower extremity Joint replacement surgery
Enhanced immediate post-op pain control, reduced blood loss and transfusions with spinal anaesthesia.[18]
Lower risk of major and minor complications with spinal anaesthesia.[19]
Spinal anaesthesia +/- peripheral nerve blocks more commonly employed in same day discharge joint replacement arthroplasty.[20]
• Peripheral nerve catheters (In-patient and ambulatory)[21,22]
Superior analgesia up to 48 hours after orthopedic surgery.
Earlier resumption of rehabilitation and physiotherapy with smoother transition to recovery.
May allow some surgeries to be performed as a day-care procedure, reducing costs.
• Orthopedic surgery in general[23]
PNBs associated with enhanced post-op pain control, less opioid use and & related side-effects, shortened LOS.
Earlier physical therapy initiation, reduced readmissions, higher patient satisfaction, faster recovery, and fewer unplanned admissions for pain.
5. Major Abdominal surgery
• In general (Mixed surgical types including GI, Hepatobiliary; Urology - Open nephrectomy/cystectomy; AAA)
Reduced respiratory complications.[24]
Reduced rest pain scores.; Inconclusive reduction in dynamic pain.[25]
Reduced time to return of bowel function.[26]
Conflicting data on the impact on hospital length of stay.[26]
• Open AAA
Reduced blood loss and quicker time to mobilize.[24]
• Upper abdominal (Gastrectomy/esophagectomy)
Reduced dynamic pain scores and pulmonary complications.[27]
6. Trauma Service
• Rib fractures
Serratus anterior plane catheters, erector spinae catheters, thoracic epidurals, and paravertebral catheters reduce rib fracture pain, some methods also lower opioid use and delirium risk.[28,29]
TEA with local anaesthetics may shorten mechanical ventilation duration but the role of TEA is often debated due to limited improvement in critical endpoints like mortality and ICU/hospital stay duration.[30]
• Hip fractures
Analgesia: High-quality evidence shows nerve blockade decreases hip fracture/ surgery pain; moderate-quality evidence highlights fewer pneumonia cases, faster mobilization, and cost-effective analgesics.[31]
Anaesthesia: In elderly hip surgery patients, regional and general anaesthesia yielded comparable results in post-operative delirium, survival, and ambulation, indicating anaesthesia choice should be tailored to the patient.[32]
7. APS: Ketamine infusions[33]
Perioperative use in a multimodal analgesic regimen for patients who are at risk for significant post-operative pain.
Perioperative use for opioid-tolerant individuals.
Analgesic adjunct for opioid-tolerant in sickle cell crisis.
Analgesic aid for patients with OSA.
8. Transitional Pain Clinic/Perioperative Surgical home - pain management[34]
Anaesthesiologists and APS experts provide opioid-alternative solutions and streamline perioperative care; multimodal analgesia has revolutionized this care.
Transitional pain clinic physicians are skilled in managing complex opioid-tolerant patients on buprenorphine or methadone in the perioperative period.
Improved perioperative care, crucially reducing post-surgery opioid reliance amid the opioid crisis.
RA, regional anaesthesia; APS, acute pain service; LOS, length of stay; AVF, arteriovenous fistula; AVG, arteriovenous graft; ICU, intensive care unit; AAA, abdominal aortic aneurysm, OSA, obstructive sleep apnea.

warranted.[13,14] Within vascular surgery, RA is associated with improved vessel patency, reduced failures, and eased transitions from arteriovenous graft to arteriovenous fistula post-dilation, attributed mainly to the sympathectomy effects of nerve blockade.[15] For carotid endarterectomy, RA was deemed more cost-effective than general anaesthesia (GA) and was accompanied by shorter operative durations, reduced hospital stays, and fewer complications.[16] Recent research also credited RA with lower in-hospital mortality rates in comparison to GA.[17] Overall, for high-risk vascular surgery patients, RA often outperformed GA, though GA continues to be a dependable option when RA is not feasible.

RA is extensively used for orthopedic surgeries. In joint replacement surgeries, RA is associated with enhanced immediate post-operative pain relief, reduced blood loss, and fewer transfusions.[18] Furthermore, a decreased risk of both major and minor complications was observed with spinal anaesthesia.[19] Neuraxial anaesthesia, often combined with peripheral nerve blocks, improves readiness for discharge by reducing pain, opioid use, and post-operative nausea and vomiting, making it a frequent choice for same-day discharge arthroplasties.[20] Peripheral nerve block catheters, used either in inpatient or ambulatory settings, have been shown to provide superior analgesia for up to 48 hours after orthopedic surgery.[21] This analgesic benefit facilitates early initiation of rehabilitation and physiotherapy, potentially facilitating some surgeries to transition to a day-care model, offering cost efficiencies.[21,22] Broadly, in orthopedic surgeries, peripheral nerve blocks (PNBs) enhance post-operative pain control, reduce opioid use and associated side-effects, shorten hospital stays, allow earlier initiation of physical therapy, cut readmission rates, improve patient satisfaction, and prevent unplanned pain admissions.[23]

In major abdominal surgeries-covering gastrointestinal, hepatobiliary, and urological procedures-varied RA techniques, such as thoracic epidural anaesthesia (TEA), intrathecal morphine, and fascial plane blocks like transversus abdominus plane and quadratus lumborum blocks are employed. Some of these techniques reduce respiratory complications and resting pain scores.[24,25] Moreover, they facilitate a quicker return of bowel function, though their impact on hospital length of stay remains debated.[26] In addition, for open abdominal aortic aneurysm (AAA) surgeries, RA led to diminished blood loss and faster post-operative mobilization.[24] In gastrectomies and esophagectomies, RA was associated with decreased dynamic pain scores and the previously mentioned benefits.[27]

In trauma patients, for managing rib fractures, techniques like TEA, paravertebral catheters, serratus anterior plane, and erector spinae block catheters reduced pain, with some also decreasing opioid use and delirium risk.[28,29] While TEA might shorten mechanical ventilation, its broader efficacy remains debated.[30] For hip fractures, nerve blocks effectively alleviate pain. Additional benefits include reduced pneumonia risk and quicker mobilization.[31] In elderly hip fracture patients undergoing surgery, both RA and GA showed comparable post-operative results, emphasizing individualized choices.[32]

Beyond RA techniques, ketamine infusions overseen by APS can benefit patients experiencing significant post-operative pain, those tolerant to opioids, and individuals with conditions such as sickle cell disease or obstructive sleep apnea.[33] Additionally, transitional pain clinics, often viewed as extensions of the APS, tackle postoperative and procedural pain, forming a bridge between hospitals and the community.[34] These clinics, developed in response to escalating costs of chronic pain management and the opioid crisis, emphasize non-opioid approaches. Anaesthesiologists and APS specialists handle complex surgical patients at risk of persistent postoperative pain, including those on medications such as buprenorphine or methadone, during the perioperative phase.

Role of RA & APS in Enhancing Health Care Efficiency and Decreasing Costs

RA techniques not only enhance patient outcomes-by reducing pulmonary complications, shortening ICU stays, improving AV fistula survival, and promoting early bowel recovery but also drive cost-effectiveness and heightened efficiency. In this section, we will further explore these fiscal and operational advantages, highlighting a few studies that underscore the economic and efficiency benefits of RA (Table 2).

Summary of Studies on Efficiency and Cost-Effectiveness

A systematic review of 28 studies involving 27,581 patients found that RA in ambulatory surgery resulted in lower overall hospital costs. This decrease was largely due to reduced OR times, faster post-anaesthesia recovery, and shorter hospital stays.[35] Another review, involving 8,888 patients, reported that among 3,364 patients who used parallel processing with RA, there was a reduction of anaesthesia-controlled time (ACT) by 10.4 minutes and turnover time by 16.1 minutes. Furthermore, Postanesthesia Care Unit (PACU) time was shortened by 26.6 minutes, allowing for an increase in daily OR throughput by 1.7 cases on average.[36]

Multiple studies have demonstrated that the optimization of systems to support RA and APS services can improve OR efficiency and throughput. In a study of 993 joint arthroplasty patients, introducing a RA block room reduced OR time by 23 minutes and ACT by 20 minutes; the use of peripheral nerve blocks increased from 63.1% to 87.0%; 1 additional surgery was added each day.[37] In another study comparing 688 traditional cases to 905 high-throughput cases in joint arthroplasties, the introduction of an adjacent "induction room" and other systematic changes increased the number of surgeries from 2.6 to 3.4 per room per day.

Table 2. RA & APS Studies: Evidence for Enhancing Efficiency and Decreasing Costs

Year Published with Reference	Number of Patient	Study Details	Outcomes and Relevant Results
Systematic Reviews			
2023[35]	27,581 patients from 28 studies	Systematic review of regional anaesthesia in ambulatory surgery	Lower total hospital costs due to reductions in OR time, post anaesthesia recovery time, and shorter hospital stays.
2020[36]	8,888 (3,364 with parallel processing)	Systematic review on advantages of parallel processing in regional anaesthesia	Reduced anaesthesia controlled time (ACT) by 10.4 minutes, turnover time by 16.1 minutes, and PACU stay by 26.6 minutes. Increased daily OR throughput by 1.7 cases.
Studies Assessing Efficiency & Throughput			
2021[37]	993 (561 preintervention; 432 postintervention).	Quality improvement study to assess the cost-effectiveness of a regional anaesthesia block room in decreasing OR time for TJA.	Reduced OR time by 23 minutes and ACT by 20 minutes. Increased peripheral nerve block use from 63.1% to 87.0%. Added an extra primary case per daily OR list.
2007[38]	- 688 (historic control) - 905 (high throughput cases)	Parallel processing system for lower extremity joint arthroplasties, which included an adjacent "induction room" and other systematic changes.	- Throughput increased from 2.6 to 3.4 surgeries per day per room. - Non-operative time decreased by 36 minutes. - Operative time reduced by 14 minutes per case. - Financial performance saw a 19.6% contribution margin increase
2011[39]	328 (164 in RA-SRs; 164 in GA-OR).	Hand and wrist surgery with regional anaesthesia and two swing operating rooms (SRs)	OR time reduced by 23 min; anaesthesia controlled OR time decreased by 20 min; increased peripheral nerve block usage from 63.1% to 87.0%; an additional TJA case added per daily OR list.
2017[40]	254 (112 pre-block room; 142 post-block room).	Retrospective review assessing impact of thoracic epidural placements in a preoperative block room over a 12-month period.	Reduction in anaesthesia-controlled OR time by 22.9 minutes, increased OR waiting time by 3.8 minutes, net OR time savings of 19.1 minutes per epidural, and decreased epidural failure rate from 16.0% to 5.6%.
Studies Evaluating Cost-Effectiveness			
2019[41]	14,713	Analysis of costs associated with ACLR considering patient demographics, perioperative decisions, and surgical location using the State Ambulatory Surgery and Services Database	Average cost: $24,707; main cost contributors: use of general anaesthesia alone ($2,049 increase), Hispanic ethnicity ($1,828 increase), >1 chronic condition ($1,749 increase)
2016[42]	154 (115 with nerve blocks; 39 without)	Review of patients having ACL reconstruction assessing the impact and cost-effectiveness of regional anaesthesia-based pain management.	RA associated with reduced rate of unanticipated hospital admissions, shorter post anaesthesia care unit phase II time, decreased opioid consumption; dedicated block rooms were most cost-effective; nerve block patients had quicker discharge readiness.
2017[43]	346	Carotid endarterectomy with RA vs GA	RA was more cost-effective with lower median costs ($7,122 vs $10,140), shorter operative times (134 min vs 168 min), and reduced in-hospital stays (1.2 vs 2.0 days)
2016[44]	120	Assessor-blinded, prospective cohort study comparing day-care vs. in-patient groups using continuous popliteal sciatic nerve block for foot surgery.	Reduced total management costs in day-care group, no difference in pain, persistent pain, PONV, motor block, or inflammation, comparable number of ambulatory visits and readmissions.

RA, regional anaesthesia; GA, general anaesthesia; OR, operating room; APS, acute pain service; AVG, arteriovenous graft; ACLR, anterior cruciate ligament reconstruction; AAA, abdominal aortic aneurysm, PONV, postoperative nausea and vomiting; TJA, total joint arthroplasty.

Additionally, nonoperative time decreased by 36 minutes, operative time by 14 minutes, and contribution margins increased by 19.6%.[38] In a cohort of 328 hand and wrist surgeries using two operating rooms, reductions of 23 and 20 minutes were observed in OR and ACT times, respectively.[39] A 12-month retrospective study of 254 patients revealed that using thoracic epidural placements in a preoperative block room led to a net OR time saving of 19.1 minutes and reduced the epidural failure rate from 16.0% to 5.6%.[40]

Examining studies that focus on cost-effectiveness, an analysis of 14,713 anterior cruciate ligament (ACL) repair patients reported an average surgical cost of $24,707, with increases associated with the use of GA alone without RA, Hispanic ethnicity, and the presence of multiple chronic conditions.[41] In another study, among 154 ACL reconstruction patients, those with RA had fewer unexpected hospital admissions, shorter PACU stays, reduced opioid consumption, and quicker discharge readiness.[42] In a study of 346 carotid endarterectomy patients, RA proved to be more cost-effective, with costs amounting to $7,122 as opposed to $10,140 for GA. Additionally, RA was associated with shorter operative and hospital times.[43] A 2016 study of 120 patients compared the costs of continuous popliteal sciatic nerve block for foot surgery and found cost benefits in outpatient surgery settings without compromising patient outcomes.[44]

Integration of RA and APS with VBHC

Integrating RA and APS into VBHC focuses on improving patient outcomes and optimizing resources. VBHC rewards quality over volume, ensuring transparent outcome reporting and patient-centered care. Understanding this integration demands insight into the healthcare delivery transition. The shift from traditional fee-for-service to value-based payment models has given rise to several VBHC models. Bundled Payments offer a fixed price for a service bundle, while Shared Savings Programs, like the Medicare Shared Savings Program, incentivize cost-saving. Capitation involves a fixed monthly payment to physicians for specified services. Other notable models include Pay for Performance, such as CMS's Hospital Value-Based Purchasing Program, and Patient-Centered Medical Homes that prioritize care coordination; Value-Based Contracting linking drug payments to effectiveness; the Global Budgets model, such as Maryland's All-Payer Model; and Shared Risk Models involving both savings and losses.

In surgery, bundled payments are prominent. They consider expenses from preoperative to postoperative care, exemplified by CMS's Bundled Payments for Care Improvement and Comprehensive Care for Joint Replacement models. However, its adoption varies by region, procedure, and healthcare setting. While fee-for-service persists, there's a trend towards value-based systems, sometimes blending in hybrid models.

For successful RA/APS and VBHC integration, identifying optimal patient groups and crafting tailored RA and APS protocols is paramount. Collaborative teams of surgeons, anaesthesiologists, pain experts, and other professionals ensure thorough pain management. Establishing metrics for RA and APS efficiency, centered on patient recovery and satisfaction, remains essential.

Benefits of VBHC for the Stake Holders

RA/APS offer substantial advantages to the core participants in today's healthcare ecosystem, which includes patients, healthcare providers, healthcare system administration (HSA), payers, employers, and vendors. For patients, VBHC provides a quicker recovery process paired with cost-efficiency. The focus on prevention results in fewer doctor visits, fewer medical procedures, and less medication cost. Integrating RA/APS into this model provides patients with advanced pain management strategies such as nerve blocks, offering superior benefits over opioids, as extensively discussed in the preceding sections. Moreover, RA/APS providers work to comprehend and address patient expectations, simplifying medical jargon and enhancing communication and trust.

Healthcare providers, including RA/APS professionals, experience enhanced operational efficiency as VBHC emphasizes streamlined, consistent protocols. The synergy between RA/APS, surgical, and nursing teams augments operating room productivity, conserving both time and money. Additionally, the shift from volume to value propels providers to champion quality, assuring superior clinical results. HSAs greatly benefit from integrating RA/APS into a VBHC framework. Adopting specialized protocols not only enhances operating room efficacy by reducing ACT and turnover time but also optimizes metrics like PACU, refining patient flow, as supported with evidence in previous sections. This reduces staff overtime and consequently lowers operational expenses. Elevating the contribution margin via increased daily case numbers during regular operational hours bolsters the system's financial health. Notably, RA/APS's role in curbing hospital readmissions due to pain issues can boost a facility's value base purchasing status.

For payers within VBHC, there's an opportunity to achieve superior cost management through bundled payments, while also reducing risks. RA/APS services, through strategic alliances, present enhanced communication, and data sharing, offering a holistic view of patient care and potential financial gains. The rise of value-centered initiatives places RA/APS firmly within the broader perioperative context,

turning hurdles into opportunities. By cultivating strategic partnerships in frameworks like the perioperative surgical home (PSH) and enhanced recovery after surgery, and establishing strong localized data management systems, RA/APS emerges as a pivotal entity during detailed contract talks. Employers, vital in healthcare due to their role in insurance provision, recognize the value in the cost reductions RA/APS's efficient care pathways bring. These pathways speed up an employee's return to work and minimize disability durations, resulting in enduring fiscal advantages. Lastly, vendors, particularly pharmaceutical companies, and medical device manufacturers, can align their product prices with the real value they deliver to patients within VBHC. The emphasis on actual outcomes enables vendors to market their products more efficiently.

Future Horizons: Role of RA and APS in Advancing VBHC

The last two decades have witnessed a paradigm shift in healthcare, evolving from a volume-driven approach to one rooted in value. The essence of VBHC is to deliver optimal health outcomes for every dollar spent, placing the patient squarely at the center of this framework. As Porter and Teisberg suggested in 2006, the aim is to align healthcare providers and payers with the objective of enhancing patient outcomes while managing costs.[2] However, this transition, though gaining momentum, faces several challenges: a value crisis where costs rise without corresponding improvement in outcomes;[45] an evidence crisis, characterized by the rapid expansion of biomedical knowledge but slow integration into clinical practice;[46] and a purpose crisis, seen in the widening gap between healthcare professionals' ideals and their working realities.[47]

In this evolving landscape, RA and APS play a pivotal role. Over 100 million Americans grapple with chronic pain, leading to treatments costing over $635 billion annually surpassing expenses for heart disease and cancer.[48] The opioid crisis, partly stemming from postoperative opioid prescriptions, highlights the pressing need for alternative pain management strategies. The transformative potential of RA is evident here. As anaesthesiologists, integrating RA into perioperative pain medicine can significantly reduce opioid prescriptions, especially when collaborating with comprehensive surgical teams. Institutions combining anaesthesia pain management services with multimodal analgesia and RA observe notably improved postoperative pain control and reduced opioid dependency. Moreover, RA's advanced techniques can streamline patient discharge plans and offer evidence-based guidelines for opioid prescriptions when necessary. This approach not only improves patient outcomes but also boosts the overall value in healthcare delivery. The Michigan Opioid Prescribing Engagement Network-OPEN initiative fosters evidence-based practices to minimize perioperative opioid use by uniting hospitals and payers. This partnership standardizes protocols, curtails excessive opioid prescriptions post-surgery, and ensures safer pain management for patients statewide.

The integration of RA and APS into VBHC extends beyond immediate opioid reduction. It signifies a move towards future-oriented medicine that prioritizes research and evidence-based practice. Highlighting a holistic approach, the PSH provides a comprehensive view of surgical care, with pain management as a primary focus.[49] Transitional pain clinics serve as a bridge between immediate postoperative pain relief and long-term pain prevention strategies.[34] Collectively, these models advocate a coordinated approach that elevates patient outcomes, focusing on pain management. Such endeavors emphasize the need for ongoing research, especially in customizing RA techniques to individual patient needs, adjusting interventions for specific surgical procedures, and understanding the long-term benefits of RA in averting chronic pain and reducing hospital readmissions. Within VBHC's broader framework, in-depth research into RA promises to decrease complications, enhance patient satisfaction, and judiciously allocate resources.

Governments and healthcare institutions worldwide are acknowledging the need to integrate VBHC objectives with clinical practice. As observed in the Netherlands and Singapore, strategies prioritize outcomes-based healthcare, emphasizing the importance of standardized outcome metrics and value-based payment models.[50] However, fully realizing VBHC's potential depends on global collaboration, exchanging best practices, and consolidating resources. Initiatives like the Global Coalition for Value in Healthcare under the World Economic Forum illustrate the promising future that awaits.

In conclusion, as healthcare transitions to value-centric models, RA and APS emerge as foundational strategies that profoundly impact patient outcomes and the financial landscape of healthcare, rather than mere adjuncts. Their integration into the VBHC framework not only elevates the quality of care, reduces costs, and enhances efficiency but also offers a guiding light in addressing some of the most pressing challenges in modern medicine. Emphasizing research in this area and translating findings into clinical practice will be pivotal in shaping the future of healthcare.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - S.R., Y.S.R., K.B.-W., J.W., S.A.; Design - S.R., Y.S.R., K.B.-W., J.W., S.A.; Data Collection or Processing - S.R., Y.S.R., K.B.-W., J.W., S.A.; Analysis or Interpretation - S.R., Y.S.R., K.B.-W., J.W., S.A.; Literature Search - S.R., Y.S.R., K.B.-W., J.W., S.A.; Writing - S.R., Y.S.R., K.B.-W., J.W., S.A.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: The authors declared that this study had received no financial support.

References

1. What Is Value-Based Healthcare? *Catalyst Carryover*. 2017;3(1). [CrossRef]
2. Porter ME, Teisberg EO. Redefining health care: creating value-based competition on results. Harvard business press; 2006. [CrossRef]
3. Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. *Health Aff (Millwood)*. 2008;27(3):759-769. [CrossRef]
4. Center for Medicare and Medicaid Services: National health expenditure data. Accessed: September 24, 2023. https://www.cms.gov/data-research/statistics-trends-and-reports/national-health-expenditure-data/nhe-fact-sheet [CrossRef]
5. Institute of Medicine Committee on Quality of Health Care in A. In: Kohn LT, Corrigan JM, Donaldson MS, eds. To Err is Human: Building a Safer Health System. Washington (DC): National Academies Press (US); 2000. [CrossRef]
6. Kaye DR, Luckenbaugh AN, Oerline M, et al. Understanding the costs associated with surgical care delivery in the medicare population. *Annals of Surgery*. 2020;271(1):23-28. [CrossRef]
7. Hutton M, Brull R, Macfarlane AJR. Regional anaesthesia and outcomes. *BJA Educ*. 2018;18(2):52-56. [CrossRef]
8. McIsaac D, Cole E, McCartney C. Impact of including regional anaesthesia in enhanced recovery protocols: a scoping review. *Br J Anaesth.* 2015;115(Suppl 2):ii46-ii56. [CrossRef]
9. Bauer C, Hentz JG, Ducrocq X, et al. Lung function after lobectomy: a randomized, double-blinded trial comparing thoracic epidural ropivacaine/sufentanil and intravenous morphine for patient-controlled analgesia. *Anesth Analg*. 2007;105(1):238-244. [CrossRef]
10. Licker MJ, Widikker I, Robert J, et al. Operative mortality and respiratory complications after lung resection for cancer: impact of chronic obstructive pulmonary disease and time trends. *Ann Thorac Surg.* 2006;81(5):1830-1837. [CrossRef]
11. Shelley BG, McCall PJ, Glass A, Orzechowska I, Klein AA. Association between anaesthetic technique and unplanned admission to intensive care after thoracic lung resection surgery: the second Association of Cardiothoracic Anaesthesia and Critical Care (ACTACC) National Audit. *Anaesthesia*. 2019;74(9):1121-1129. [CrossRef]
12. Wong J, Cooper J, Thomas R, Langford R, Anwar S. Persistent postsurgical pain following thoracotomy: a comparison of thoracic epidural and paravertebral blockade as preventive analgesia. *Pain Med*. 2019;20(9):1796-1802. [CrossRef]
13. King M, Stambulic T, Servito M, Mizubuti GB, Payne D, El-Diasty M. Erector spinae plane block as perioperative analgesia for midline sternotomy in cardiac surgery: A systematic review and meta-analysis. *J Card Surg*. 2022;37(12):5220-5229. [CrossRef]
14. Zhou K, Li D, Song G. Comparison of regional anesthetic techniques for postoperative analgesia after adult cardiac surgery: bayesian network meta-analysis. *Front Cardiovasc Med*. 2023;10:1078756. [CrossRef]
15. Ismail A, Abushouk AI, Bekhet AH, et al. Regional versus local anesthesia for arteriovenous fistula creation in end-stage renal disease: a systematic review and meta-analysis. *The Journal of Vascular Access*. 2017;18(3):177-184. [CrossRef]
16. Leichtle SW, Mouawad NJ, Welch K, Lampman R, Whitehouse WM Jr, Heidenreich M. Outcomes of carotid endarterectomy under general and regional anesthesia from the American College of Surgeons' National Surgical Quality Improvement Program. *J Vasc Surg*. 2012;56(1):81-88.e3. [CrossRef]
17. Hussain AS, Mullard A, Oppat WF, Nolan KD. Increased resource utilization and overall morbidity are associated with general versus regional anesthesia for carotid endarterectomy in data collected by the Michigan Surgical Quality Collaborative. *J Vasc Surg*. 2017;66(3):802-809. [CrossRef]
18. Memtsoudis SG, Cozowicz C, Bekeris J, et al. Anaesthetic care of patients undergoing primary hip and knee arthroplasty: consensus recommendations from the International Consensus on Anaesthesia-Related Outcomes after Surgery group (ICAROS) based on a systematic review and meta-analysis. *Br J Anaesth*. 2019;123(3):269-287. [CrossRef]
19. Warren J, Sundaram K, Anis H, et al. Spinal anesthesia is associated with decreased complications after total knee and hip arthroplasty. *J Am Acad Orthop Surg*. 2020;28(5):e213-e221. [CrossRef]
20. Yap E, Wei J, Webb C, Ng K, Behrends M. Neuraxial and general anesthesia for outpatient total joint arthroplasty result in similarly low rates of major perioperative complications: a multicentered cohort study. *Reg Anesth Pain Med.* 2022;47(5):294-300. [CrossRef]
21. Ilfeld BM. Continuous peripheral nerve blocks: an update of the published evidence and comparison with novel, alternative analgesic modalities. *Anesth Analg*. 2017;124(1):308-335. [CrossRef]
22. Ranganath Y, Seering M, Marian A. Curb your enthusiasm: local anesthetic adjuvants for peripheral nerve blocks. *ASRA News*. 2020;45(4). [CrossRef]
23. Kamel I, Ahmed MF, Sethi A. Regional anesthesia for orthopedic procedures: What orthopedic surgeons need to know. *World J Orthop*. 2022;13(1):11-35. [CrossRef]
24. Guay J, Kopp S. Epidural pain relief versus systemic opioid-based pain relief for abdominal aortic surgery. *Cochrane Database Syst Rev*. 2016;2016(1):Cd005059. [CrossRef]
25. Rigg JR, Jamrozik K, Myles PS, et al. Epidural anaesthesia and analgesia and outcome of major surgery: a randomised trial. *Lancet.* 2002;359(9314):1276-1282. [CrossRef]
26. Guay J, Nishimori M, Kopp S. Epidural local anaesthetics versus opioid-based analgesic regimens for postoperative gastrointestinal paralysis, vomiting and pain after abdominal surgery. *Cochrane Database Syst Rev*. 2016;7(7):Cd001893. [CrossRef]
27. Hughes M, Yim I, Deans DAC, Couper GW, Lamb PJ, Skipworth RJE. Systematic review and meta-analysis of epidural analgesia versus different analgesic regimes following oesophagogastric resection. *World J Surg*. 2018;42(1):204-210. [CrossRef]
28. Beard L, Hillermann C, Beard E, et al. Multicenter longitudinal cross-sectional study comparing effectiveness of serratus anterior plane, paravertebral and thoracic epidural for the analgesia of multiple rib fractures. *Reg Anesth Pain Med*. 2020;45(5):351-356. [CrossRef]

29. Peek J, Smeeing DPJ, Hietbrink F, Houwert RM, Marsman M, de Jong MB. Comparison of analgesic interventions for traumatic rib fractures: a systematic review and meta-analysis. *Eur J Trauma Emerg Surg.* 2019;45(4):597-622. [CrossRef]
30. 30. Carrier FM, Turgeon AF, Nicole PC, et al. Effect of epidural analgesia in patients with traumatic rib fractures: a systematic review and meta-analysis of randomized controlled trials. *Can J Anaesth*. 2009;56(3):230-242. [CrossRef]
31. 31. Guay J, Parker MJ, Griffiths R, Kopp S. Peripheral nerve blocks for hip fractures. *Cochrane Database Syst Rev*. 2017;5(5):Cd001159. [CrossRef]
32. Neuman MD, Feng R, Carson JL, et al. Spinal anesthesia or general anesthesia for hip surgery in older adults. *N Engl J Med.* 2021;385(22):2025-2035. [CrossRef]
33. Schwenk ES, Viscusi ER, Buvanendran A, et al. Consensus guidelines on the use of intravenous ketamine infusions for acute pain management from the American Society of regional anesthesia and pain medicine, the American Academy of pain medicine, and the American Society of Anesthesiologists. *Reg Anesth Pain Med*. 2018;43(5):456-466. [CrossRef]
34. Mikhaeil J, Ayoo K, Clarke H, Wąsowicz M, Huang A. Review of the transitional pain service as a method of postoperative opioid weaning and a service aimed at minimizing the risk of chronic post-surgical pain. *Anaesthesiol Intensive Ther.* 2020;52(2):148-153. [CrossRef]
35. Graff V, Gabutti L, Treglia G, et al. Perioperative costs of local or regional anesthesia versus general anesthesia in the outpatient setting: a systematic review of recent literature. *Braz J Anesthesiol*. 2023;73(3):316-339. [CrossRef]
36. El-Boghdadly K, Nair G, Pawa A, Onwochei DN. Impact of parallel processing of regional anesthesia with block rooms on resource utilization and clinical outcomes: a systematic review and meta-analysis. *Reg Anesth Pain Med*. 2020;45(9):720-726. [CrossRef]
37. Mazda Y, Peacock S, Wolfstadt J, Matelski J, Chan V, Gleicher YJ. Developing a business case for a regional anesthesia block room: up with efficiency, down with costs. *Reg Anesth Pain Med*. 2021;46(11):986-991. [CrossRef]
38. Smith MP, Sandberg WS, Foss J, et al. High-throughput operating room system for joint arthroplasties durably outperforms routine processes. *Anesthesiology*. 2008;109(1):25-35. [CrossRef]
39. Head SJ, Seib R, Osborn JA, Schwarz SK. A "swing room" model based on regional anesthesia reduces turnover time and increases case throughput. *Can J Anaesth*. 2011;58(8):725-732. [CrossRef]
40. Gleicher Y, Singer O, Choi S, McHardy P. Thoracic epidural catheter placement in a preoperative block area improves operating room efficiency and decreases epidural failure rate. *Reg Anesth Pain Med*. 2017;42(5):649-651. [CrossRef]
41. Bokshan SL, Mehta S, DeFroda SF, Owens BD. What are the primary cost drivers of anterior cruciate ligament reconstruction in the United States? A cost-minimization analysis of 14,713 patients. *Arthrosc J Arthrosc Relat Surg.* 2019;35(5):1576-1581. [CrossRef]
42. Denise Michelle H-B, Mark EH, Jan SG, Sarah C, Katherine B, Karen RB. Regional anesthesia is cost-effective in preventing unanticipated hospital admission in pediatric patients having anterior cruciate ligament reconstruction. *Reg Anesth Pain Med.* 2016;41(4):527. [CrossRef]
43. Siu A, Patel J, Prentice HA, Cappuzzo JM, Hashemi H, Mukherjee D. A cost analysis of regional versus general anesthesia for carotid endarterectomy. *Ann Vasc Surg*. 2017;39:189-194. [CrossRef]
44. Saporito A, Calciolari S, Ortiz LG, Anselmi L, Borgeat A, Aguirre J. A cost analysis of orthopedic foot surgery: can outpatient continuous regional analgesia provide the same standard of care for postoperative pain control at home without shifting costs? *Eur J Health Econ*. 2016;17(8):951-961. [CrossRef]
45. Brownlee S, Chalkidou K, Doust J, et al. Evidence for overuse of medical services around the world. *The Lancet*. 2017;390(10090):156-168. [CrossRef]
46. Kirchner JE, Smith JL, Powell BJ, Waltz TJ, Proctor EK. Getting a clinical innovation into practice: an introduction to implementation strategies. *Psychiatry research*. 2020;283:112467. [CrossRef]
47. Rouse WB, Serban N. *Understanding and managing the complexity of healthcare*. MIT Press; 2014. [CrossRef]
48. Institute of Medicine Committee on Advancing Pain Research C, Education. The National Academies Collection: Reports funded by National Institutes of Health. *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research*. National Academies Press (US) Copyright © 2011, National Academy of Sciences. 2011. [CrossRef]
49. Pozek J-PJ, De Ruyter M, Khan TW. Comprehensive acute pain management in the perioperative surgical home. *Anesthesiol Clin.* 2018;36(2):295-307. [CrossRef]
50. Larsson S, Clawson J, Howard R. Value-based health care at an inflection point: a global agenda for the next decade. *NEJM Catalyst.* 2023;4(1). [CrossRef]

DOI: 10.4274/TJAR.2023.231387

Review Article
Historical Note

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):459-464

The First Hundred Years of the Scientific Field of Anaesthesiology and Reanimation in the Republic of Turkey

Hatice Türe[1], Haluk Gümüş[2]

[1]Yeditepe University Faculty of Medicine, Department of Anaesthesiology and Reanimation, İstanbul, Turkey
[2]Retired, Anaesthesiology and Reanimation Specialist, Ankara, Turkey

Cite this article as: Türe H, Gümüş H. The First Hundred Years of the Scientific Field of Anaesthesiology and Reanimation in the Republic of Turkey. *Turk J Anaesthesiol Reanim.* 2023;51(6):459-464.

Abstract

As a scientific field, anaesthesiology and reanimation, with their significant place in the medical structure, have been practised since the beginning of surgical procedures. Today anaesthesiology and reanimation speciality cover more complex techniques and areas than alleviating patients' pain during surgery. In the first hundred years since the proclamation of the Turkish Republic, the path covered in our scientific field is to pave the way for the next hundred years.

Keywords: Anaesthesiology and reanimation, history, the Republic of Turkey

Main Point

- In the first hundred years since the proclamation of the Turkish Republic, the path covered in our scientific field is to pave the way for the next hundred years.

Introduction

The scientific field of anaesthesiology and reanimation, with scientific and technological innovations, has been improved from the first definition of anaesthesia, which is "painlessness and numbness required for surgical procedure", and developed into an indispensable branch that manages the perioperative medical status of the patient by balancing it's vital functions as a whole and by maintaining that balance. In Intensive Care Units, part of the anaesthesiology and reanimation field, patients needing advanced diagnoses and follow-ups are treated. Algology, a relatively new science, covers all pain management therapies in pain clinics and is growing with recent conformational changes.

The improvement and progress made with the guidance of pioneer physicians of our field in the first hundred years of the Turkish Republic will pave the way and enlighten us in future centuries.

Corresponding author: Hatice Türe, e-mail: htcture@yahoo.com

Received: June 29, 2023 Accepted: November 29, 2023

Main Text

Since the first day of human history, anaesthesia has been required to perform surgery.[1] The modern history of our area has been shaped by the energy of our young and dynamic Turkish Republic, surviving the Independence War. In the first years of the Turkish Republic, while the Turkish people coming out of war were creating the new future, physicians loyal to their country made intense efforts in the field of anaesthesia. "Cemil Topuzlu, Besim Ömer Akalın, Orhan Abdi Kurtaran, Rıza Nur, Burhanettin Toker, Kâzım İsmail Gürkan, Akif Şakir Sakar, Ahmed Asım Onur, and Halit Ziya Konuralp" contributed to anaesthesiology and reanimation field, seeing its indispensability in performance of surgical procedures.[2-6]

When written sources about these periods are reviewed from the articles published by Burhanettin Toker in 1924, Kâzım İsmail Gürkan in 1926, and H. Ziya Konuralp in 1931, we learn that newly developed drugs were used widely in our country. Just before university reforms of 1933 as modern and scientific developments applied according to global standards, the articles "Painless Labor" by Tevfik Remzi Kazancıgil in 1929, "Monograph of Painless Labor" by Asim Onur in 1932, two articles about painless labour, and "Pernokton in Labor Analgesia" by Ziya Üstün in 1933, are essential documents of the history of anaesthesia. One of the pioneer anaesthesiology and reanimation specialists in Turkey, Prof. Dr. Cemalettin Öner, states that he has encountered 26 articles from this period.[1,3] As anaesthesia and reanimation were a novelty field worldwide, new devices were being developed to anaesthetise patients. Following the university reform in Turkey, in 1937, famous surgeon, Prof. Dr. Rudolph Nissen brought the first anaesthesia device to Istanbul University Medical School to the I. Surgical Ward. However, at that time, no one volunteered to use this device.

Despite the increasing economic and political crises in the world during the Second World War (1935-1945), scientific and industrial revolutions have been initiated in the young Republic of Turkey to reach to the level of developed countries. At that time, ss a milestone, an anaesthesia device was brought to Istanbul University Medical School by request of Prof. Dr. Burhanettin Toker (1948). As a surgical resident, Dr. Sadi Sun has been assigned to use that mentioned device. In 1949, another milestone for anaesthesiology and reanimation field, the first endotracheal intubation has been performed by Burhaneddin Toker and Sadi Sun.[5-15] In 1950, Dr. İhsan Günalp, Dr. Ali Yücel, Dr Cemil Aksoy, Dr. Hüsrev Polat and Dr. Orhan Bumin started performing endotracheal intubation in hospitals also in Ankara.

With the transition from one-party period to multiple-party period, the country's political and geopolitical agenda became more active, and although the country remained neutral until the final stages of World War II, it always remained on the agenda due to its political position. Parallel the world direction, until the 1950s, the anaesthesia and reanimation field was not a separate branch but performed by physicians practicing in surgical fields or by assistant health providers under surgeons. In this period, Dr. Simon Batmaz, Dr. Melih Erhan and Dr. Hüseyin Ergönenç must be mentioned as pioneers of this field, as they were the first physicians to provide anaesthesia.[5,7-9,15] In 1950, Prof. Dr. Burhanettin Toker requested that the anaesthesiology speciality be a separate branch in our country, with an application letter to then Minister of Health Ekrem Hayri Üstündağ. As the application of anaesthesia increased during surgery and more complicated procedures were performed, the first anaesthesia specialist was assigned to Haydarpasa Numune Hospital in 1953. Surgeon Dr. Hüsnü Öztürk was given as a "surgical and anaesthesia specialist" by the Ministry of Health due to his interest and experience from his European studies. During the same period, Prof. Dr. Robert Kucher, from Wien, was invited to establish an anaesthesia clinic at the same hospital. His successor Dr. Wolfgang Wirtinger, from Wien, with a decree dated 3rd January 1955 and numbered 3239, established the first anaesthesia clinic and officially started anaesthesia training. Therefore 1955 is the first official establishment of our branch. Dr. Cemalettin Öner became the first official anaesthesia trainee of the Ministry of Health.[5-12] In addition to his identity as an academician, Dr. Öner contributed also made great strides in the field of anaesthesia and intensive care in our country structurally.

As women, whose education was ignored during the Ottoman era, started being an active part of educational and work life during the Republician period. For example, women were given the right to vote and be elected in Turkey in 1934, long before many European countries. The first female anaesthesiologists of the new and contemporary Turkey were Dr. Kadriye Bilge Toprak, Dr. Rüçhan Kutbay and Dr. Emel Çobanoğlu. These pioneering Turkish women will always be remembered with respect.

As tremendous advances were happening in the country at this period, in 1951, at Gülhane Military Medical Academy, the first anaesthesia practices were started by Dr. Ali Ulvi Kaya and Dr. İsmail Bağcılar.[15] In the following years, with the opening of new hospitals, new anaesthesia departments have been established. In Ankara Training Hospital in 1953, Dr. Hüsrev Polat started anaesthesia practices and, Dr Ulvi Kaya (1963), Dr. Emel Çobanoğlu and Dr. Turhan Candan contributed to the clinic.

A year later, in Training Regulation, dated 20th January 1956 and declared in the 9212th issue of Official Newspaper, numbered 4/6379, anaesthesiology was listed as a separate training field. Thus, the pioneers of this field started officially receiving their degrees.[12-15] First two to be named

are Dr. Sadi Sun, March 1956, from Istanbul University Medical School, and Dr. Cemalettin Öner, December 1956, from the Ministry of Health. Afterwards, in 1957, Dr. Moiz Kan, Dr. Cahit Bergil, Dr. Emel Berkol, Dr. Mehmet Nazlı, Dr Refik Paykoç, and Dr. Müfit Erkul, respectively; in 1958, Dr. Kamil Ergin, Dr. Faruk Or, and Dr. Orhan Toydemir were among the first ones to qualify to receive anaesthesia specialist degrees.[12-15]

In the 1950s, society of anaesthesologists was established in some countries. At the same period, anaesthesiology specialists Dr Sadi Sun, Dr Sabahat Kabaalioglu and Dr. Cezmi Kınoğlu came together with Dr. Şinasi Hakkı Erel and Dr. Fahri Arel to establish "*The Society of Anesthesia*" in 1956.[4-15] The first president of the society was Dr. Fahri Arel. Sadi Sun was elected president on April 7, 1958. Its first congress was held in Istanbul on May 9, 1965. Later, this society will be named as "*The Society of Anesthesia and Reanimation*" (TARC) in 1969. Sixteen years after the establishment of the association, "*The Journal of Turkish Anesthesiology and Reanimation Society*" (1972) began to be published. With the decision of the Council of Ministers in 1975, the name "Turkish" would be officially added to the society.

In the developing and ever-changing Turkish Republic in 1958, the first independent "Anesthesiology Institute" under Ankara University Medical School. Ankara University was founded in 1948. Dr. Hilmi Akın, a surgeon, first led the administration since trained anaesthesia specialists were scarce. Afterwards, anaesthesiology specialist Dr. Refik Paykoç took over and improved the clinic.

After establishing period, Dr. Birsen Saygın who was the first female professor of anaesthesiology developed the clinic further (1994). Dr. Melek Tulunay in the intensive care, Dr. Yeşim Ateş in algology are important names in our history with their works from this clinic. In later years, Dr. Filiz Tüzüner developed the clinic further (1994).

In 1958, at Hacettepe University Medical School in Ankara, under the ANDAY section, which is the first nucleus of this university, Dr. Emel Çobanoğlu founded Anaesthesiology Department in 1963, Dr. Suat Karasu was assigned as the department chief. When Dr. Karasu resigned, Dr. Özdemir Demir, who returned to Ankara in 1964, was appointed to be his successor in 1965. In 1967, following the foundation of Hacettepe University Medical School, Dr. Özdemir Demir, Dr. Mualla Karamehmetoglu, who received her degree in 1966, and Dr. Kemal Erdem performed successfully as chief of the anaesthesiology and reanimation department. [8,9,12,13] Later, Dr. Ülkü Aypar than Dr. Meral Kanbak will continue this duty successfully until their retirement.

While 1960 Turkish coup d'état was happened, Dr. Sadi Sun was named the first Associate Professor of Anaesthesiology in Turkey at Istanbul University Medical School.[7-13] The same clinic, in 1961, was renamed as Anaesthesiology and Reanimation Institute.

While the intensive care is celebrating its 60th anniversary this year, The concept as born from the devastating Copenhagen polio epidemic. Bjorn Ibsen, the anaesthesiologist who had suggested that positive pressure ventilation should be the treatment of choice during the epidemic, had set up the first intensive care unit in 1953. During this period, a remarkable development took place in Turkey and with the efforts of Dr. Cemalettin Öner, "Reanimation" was added to the anaesthesia title in 1963 (9-14). In the Education Regulation No. 6/821 of the Ministry of Health, the name of this scientific and hard-working physician specialty group was changed to "Anaesthesiology and Reanimation".[11,13,15]

In 1960s, the Turkish economy grew at the expected target rate and, this constituted almost an industrial revolution and a take-off of a kind which few other world states had yet managed. Parallel to these developments, the anaesthesiology and reanimation clinics and departments were opened in every corner of the country. To name the pioneer physicians who founded anaesthesiology and reanimation clinics and departments and took part in many important developments: Dr. Cahit Bergil (1956), followed by Dr. Raife Torun (1966) in Şişli Etfal Training and Research Hospital (TRH); Dr. Bernard and Dr. Mustafa Dengilioğlu as first chief of clinic (1961), and followed by Nurten Ünal in Ankara TRH; Dr. Mehmet Ali Carfi, Dr. Semiramis Oyman (1958) in İzmir Katip Çelebi Atatürk TRH; Dr. Çetin Tuna and Dr. Bekir Mutlu as first chief of clinic (1972), and followed by Dr. Mehmet Yıldırım in Ankara Numune TRH; Dr. Ali Beşirikli (1961) in Adana Numune TRH; Dr. Ercüment Kopman (1970) and followed by Dr. Sevim Canik (1986), and Dr. Zuhal Aykaç (1987) in Siyami Ersek TRH; Dr. Ulvi Kaya (1961) and Dr. Turhan Candan as first chief of clinic (1970) in Dışkapı Yıldırım Beyazıt TRH; Dr. Hale Akoğuz, Dr. Faruk Müftüoğlu (1964), Dr. Çiğdem Yakut and Dr. Sevim Erbil (1980) in Turkish Yüksek İhtisas (High Training) TRH; Dr. Yıldız Köse (1969), followed by Dr. Sabahattin Uslu in Atatürk University Medical School; Dr. Ahmet Tutan (1957/1968), followed by Dr. İbrahim Yegül (1994), and Dr. Ali Reşat Moral (2000) in Ege University Medical School; Dr. Şevket Kaya (1969) and Dr. Mehmet Sarıbay as first chief of clinic (1974) in Taksim TRH; Dr. Ali Eren (1971) in Dicle University Medical School; Dr. Hale Akoğuz (1972), Dr. Hasan Akman, Dr. Gültekin Akoğuz, Dr. A. Geylan Işık, Dr. Uğur Oral, Dr. Dilek Özcengiz in Çukurova University Medical School; Dr. Orhan Toydemir (1974), followed by Dr. Gürayten Özyurt (1982), Dr. Oya Kutlay (1991), Dr. Gülsen Korfalı, and Dr. Şükran Şahin in Uludağ University Medical School; Dr. Şahin Yardım (1975) in Erciyes University Medical School; Dr. Zafer Pamukçu and Dr. Belkıs Tanrıverdi (1974) in Eskişehir Osmangazi

University; Dr. Zeynep Esener (Kayhan) (1978), followed by Dr. H. Ayla Tür, Dr. B. Binnur Sarıhasan, and Dr. A. Haydar Şahinoğlu in Ondokuz Mayıs University.[13,15]

Despite to the political and economic problems during the 1970s in Turkey; Dr. Cemalettin Öner, Dr. Sadi Sun, Dr. Seyhan Çelikoğlu, Dr. Cemil Barlas, Dr. Umur Kaya, Dr. Hüsamettin Kerim Gökay, Dr. Faruk Or, Dr. Abdülkadir Erengül, Dr. Yıldız Köse, Dr. Beyhan Özden, Dr. Göksel Kalaycı, Dr. Kutay Akpir, Dr. Edip Kürklü, Dr. Dikmen Dolar and, Dr. Tuğrul Denkel established the "*Society of the Intensive Treatment and Care*" in 1978.

In the coming years, Gülhane Military Medical Academy has been consisting of two parts: Gülhane Military Medical Faculty (GATA) and GATA Haydarpaşa Training Hospital (1980). In GATA department of anaesthesiology; Dr. Nurettin Bayhan, Dr. Hikmet Süer, Dr. M. Erdal Güzeldemir, Dr. Ercan Kurt, Dr. Ahmet Coşar; in GATA Haydarpaşa training hospital Dr. Uğur Oral, Dr. Merih Gökben, Dr. Güner Dağlı and Dr. Sezai Özkan have been providing great contributions to the institution. Unfortunately, this well-established institution, whose roots date back to 1827, has been closed in 2016.

In addition to political problems in the 1980s, new economic development strategies were formulated, and the market economy was expanded. In historical process, many departments and clinics continued to be established in Republic of Turkey. Department of Anaesthesiology and Reanimation has been established and developed by Dr. Yener Karadenizli, Hülya Çelebi (1980), than Dr. Şahin Yardım in Gazi University; Dr. Nuri Erol İçel (1980) in Akdeniz University; Dr. Emel Sağıroğlu (1979) in Dokuz Eylül University; Dr. Safiye Atalay (1982) Karadeniz Teknik University; Dr. Osman Şengönül (1982) in Trakya University; Dr. Şeref Otelcioğlu (1983) in Necmettin Erbakan University; Dr. Güray Barlas (1983), followed by F. Yılmaz Göğüş (1986) in Marmara University Medical School; Dr. Nesrin Ertunç (1984) in Dr. Abdurrahman Yurtaslan Oncology TRH; Dr. Eser Şavkılıoğlu (1986) in Atatürk Pumonology and Thoracic Surgery TRH; Dr. Ünsal Öner (1990) in Gaziantep University.[6,8,15]

Anaesthesiology and reanimation specialists, effectively covering many medical areas, also took part in the development of algology. In 1986, the first algology clinic has been founded by Dr. Kadriye Bilge, and Dr. Serdar Erdine in İstanbul University School of Medicine. Society of Algology was founded in 1987 by Dr. Cemalettin Öner, Dr. Kutay Akpir, Dr. Kadriye Bilge ve Dr. Serdar Erdine as an anaesthesiologist. In 1990, first department of Algology was established by Dr. Serdar Erdine, and he made great contributions to the initiation and development of the science of algology in our country and the world. In 1990, Algology unit in İstanbul University İstanbul Medical Faculty was accepted as the first algology department in Turkey and contributed immensely to algology's growth in our country and in the world. In these years, healthcare services have spread rapidly all over the world. Anaesthesiology and reanimation departments continued to be established in many university hospitals and training hospitals; Dr. Zuhal Arıkan (1987) in Kartal TRH; Dr. Ömer Lütfi Erhan (1987) in Fırat University Medical School; Dr. H. Aysel Altan (1988) in Okmeydanı TRH; Dr. Gülsen Bican (1988) in Haseki TRH; Dr. Sabahattin Uslu (1990) and Dr. Ayşe Gürel (1991) in İnönü University Medical School; Dr. Rıza Dediler (1993) in Yüzüncü Yıl University; Dr. Habip Atalay (1994) and Dr. Mustafa Gönüllü (1995) in Pamukkale University; Dr. Ahmet Tutan (1994) and Dr. Nurettin Lüleci (1994) in Manisa Celal Bayar University; Dr. Kamil Toker (1995) in Kocaeli University; Dr. Ali Dolgun (1996) in Süleyman Demirel University; and Dr. Uğur Oral (1999) in Mersin University.[13,15] In the following years, university medical schools and training and research hospitals increased, making it possible to train new anaesthesiology and reanimation specialists who served nationwide.

In the 2000s, while the industry revolution 4.0 was started with internet and cyber-physical systems, the anaesthesiology and reanimation field reached high levels of education and service following its foundation's first period in all over the world. During these years, the number of trainees receiving a high level of education has increased. Thus, on 29th October 2001, Turkish Board of Anesthesiology and Reanimation (TARB) were founded to standardise clinical applications and supervise. The first board members were Dr. Kutay Akbir, Dr. Zeynep Kayhan, Dr. Aydemir Yalman, Dr. Özcan Erdemli, Dr. Serdar Erdine, Dr. Yüksel Keçik, Dr. Gülsen Korfalı, Dr. Mois Bahar, Dr. M. Erdal Güzeldemir and Dr. Hülya Çelebi.[11,15] Since its establishment, TARB has being significant efforts in order to ensure highest level of training of anaesthesiology and reanimation residents and specialists for high quality and safe healthcare to all citizens.

During Republic's history, in our country, following the formation of a scientific foundation of anaesthesiology specialty, anaesthesiology and reanimation specialists continuously provided care in operating room, intensive care units and pain clinics. When the date came to 2011, some radical changes began in our country to the detriment of anaesthesiology and reanimation specialists, and algology has been taken as a subspeciality program.

In 2012, intensive care was established as a subspeciality program which caused many anaesthesiologists that worked in intensive care units to lose their rights as specialists. But now, more than six thousand anaesthesiologists with or without subspeciality degree with national consciousness and patriotism continue to serve in operating room, intensive care and pain clinics with excellent performance.

During the 2000s, following the improvement of state universities that keep increasing numbers, anaesthesiology and reanimation departments were founded in foundation universities, and new generation government universities. Dr. Gülnaz Aslan (1994) at Başkent University; Dr. Bora Aykaç (2005) at Yeditepe University; Dr. Levent Kılıkan, Dr. Refik Paykoç, Dr. Birsen Saygın (2006) at İstanbul Bilim University; Dr. Nigar Baykan (2008) in Acıbadem University, Dr. Ömür Erçelen (2010) in Koç University; Dr. Erdoğan Öztürk (2010) in Bezm-i Alem Vakıf University; Dr. Melek Güra Çelik (2012) in Medeniyet University; Dr. Hüseyin Öz (2012) in Medipol University; Dr. Osman Ekinci (2015) in Health Sciences University; Dr. Güner Dağlı (2017) in Sanko University are to name as department founders.[15]

Until now, biggest society of the anaesthesiology and reanimation specialists is the Turkish Society of Anesthesiology and Reanimation in Turkey, and continue working on educational activities, law and personal rights. Since the foundation of the Turkish Society of Anesthesiology and Reanimation (TARD), Dr. Sadi Sun, Dr. Bora Aykaç, Dr. Kutay Akpir, Dr. Uğur Oral, Dr. Oya Kutlay, Dr. Filiz Tüzüner, Dr. Mois Bahar, Dr. Ali Reşat Moral, Dr. Ülkü Aypar, Dr. Şükran Şahin, Dr. Güner Kaya, Dr. Neslihan Alkış, Dr. Hülya Bilgin, Dr. Ömer Kurtipek, Dr. Meral Kanbak, and Dr. Ali Fuat Erdem have been presidents of the TARD successfully in first 100 years of society respectively.

In 1972, 16 years later the establishment of the society, Turkish Journal of Anaesthesiology and Reanimation (TJARD) has been published. In the early years of the journal, between 1972-1985, Dr. Abdulkadir Erengül undertook the preparation task of the journal, which consists of the proceedings of the congress held the previous year, conference contents and some articles. In 1985, Dr. Sadi Sun assigned the editor-in-chief of the journal to Dr. Mois Bahar. Between 1985 to 2002, during his 17 years of duty; the journal began to be published 4 times, then 6, 8 and 10 times a year. Later Dr. Oya Kutlay, Dr. Filiz Tüzüner, Dr. Erdal Güzeldemir, then Dr. Melek Tulunay took over this duty with the high scientific and organizational performance. Dr. Yalım Dikmen, Dr. Nüzhet Mert Şentürk, and Dr. Aslı Dönmez have reached a high scientific level over the years. Today, TJARD is a very well-known journal which has a high scientific quality and indexed by national and international databases.

In addition to Turkish Society of Anesthesiology and Reanimation, Turkish Society of Intensive Care, Turkish Society of Algology, Anesthesiology and Reanimation Specialists' Society (ARUD), Society of Thoracic and Cardiovascular Anesthesiology and Intensive Care, Society of Regional Anesthesia, Society of Clinical Enteral and Parenteral Nutrition (KEPAN), Turkish Resuscitation Council, Society of Palliative Care, Society of Clinical Toxicology were also founded by anaesthesiology and reanimation specialists.

While the date 2023, approximately 6000 anaesthesia and reanimation specialists are providing high quality healthcare in every corner of Turkey, sustaining education for physicians, and represents their country with the high scientific level internationally. Despite it is certain that they have a serious loss of rights in algology and intensive care subspecialties in recent years, anaesthesiology and reanimation specialists has continued to serve devotedly in these areas also in extraordinary circumstances such as pandemics and earthquakes.

Conclusion

From the foundation of our Republic to this day, hundred years passed; everything started with pioneer anaesthesiology and reanimation specialists who worked relentlessly to build Republican Turkey and today, the torch is passed on to the anaesthesiology and reanimation specialists who still work as relentlessly as our pioneers. National data shows us that in 2022, the number of active hospitals will be 1563, a combination of 908 county hospitals affiliated with the Ministry of Health, foundation university hospitals, and 655 private hospitals. By the end of 2022, 5687 anaesthesiology and reanimation specialists and 3907 trainees will be actively working. In this case, it is expected that the number of anaesthesiology and reanimation specialists working in our country in the next 10 years will be around 15-20 thousand. This high number requires greater preparations in terms of maintaining the currently existing high standard of education and superior service quality. It may also bring about the problem of creating employment in the field of work; Precautions should be taken to prevent "a larger workforce that will work longer hours at lower wages".

The increasing world and country population has brought about the need for more healthcare services. In parallel with this situation, it is necessary to take part in the dizzying changes in the field of technology in our country and the new digital revolution we are in. For us to be able to produce projects that will have a say in the world in the coming centuries, it is necessary to create different areas of expertise in our country with this awareness. In this process, in the rapidly changing world with technology and digitalization; also need to prepare our colleagues against situations such as crisis and depression that can lead to loneliness and inefficiency. The strength we need to keep providing a high level of education and for the next Republican generations to improve scientifically; is present "in the noble blood running through our veins". Only with fair leaders, who can create a consciousness that brings out "trust and respect" in

public for the physicians trained by us, can we successfully carry anaesthesiology and reanimation science forward for years to come.

Acknowledgements

The authors thank Prof. Dr. M. Erdal Güzeldemir for contribution and Prof. Dr. Ferdi Menda for editorial assistance.

Peer-review: Externally and internally peer-reviewed.

Author Contributions: Concept - H.T.; Design - H.T.; Data Collection or Processing - H.T.; Analysis or Interpretation - H.T., H.G.; Literature Search - H.T., H.G.; Writing - H.T.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Türe H, Türe U, Yilmaz Gögüş F, Valavanis A, Yaşargil MG. The art of alleviating pain in greek mythology. *Neurosurgery.* 2005;56(1):178-185. [CrossRef]
2. Ülman YI. Kloroformun ilk kez cerrahide kullanımı. *Tarih ve Toplum.* 1995;138:344. [CrossRef]
3. Yıldırım N. Anesteziyolojinin Tarihsel Gelişiminde Anestezi Aletleri. İstanbul: Myra Yayıncılık, 2005. [CrossRef]
4. Türe H, Havuzlu Z.Ö. Türk Sinemasında Anestezi İzleri (1895-1980). Bilgin H, Editor. Türkiye'de Anesteziyoloji ve Reanimasyon Biliminin Tarihsel Gelişimi-II. Bursa: TARD Yayınları; 2017;30-63. [CrossRef]
5. Koltka AK. Anesteziyolojinin Gelişimi. Ertan H, Salduz A, Salduz Z.İ.Y., Editors. Tıp Dallarındaki Gelişmelerin Tarihi. İstanbul: Betim Yayınları; 2021;555-573. [CrossRef]
6. Öner C. Dünya'da ve batıda anesteziyoloji ve reanimasyon gelişimi. *İstanbul Üniversitesi Tıp Fakültesi Mecmuası.* 1982;45(88):1-65. [CrossRef]
7. Sun S. İstanbul Tıp Fakültesi'nde anesteziyoloji ve reanimasyonun kuruluşu (1948-1968). *Turkish Journal of Anesthesiology and Reanimation.* 1990;18(1):5-12. [CrossRef]
8. Esener ZK. Türkiye'de Anesteziyolojinin gelişimi. Esener Z. K., Editor. Türkiye'de Anesteziyoloji. İstanbul: Atak Matbaacılık; 1996;1-5. [CrossRef]
9. Akpir K. Her Yönüyle Anestezi. İstanbul: İstanbul Nöbetçi Yayınevi; 2010. [CrossRef]
10. Alkış N. Anestezi Tarihi. *Ankara Üniversitesi Dikimevi Sağlık Hizmetleri Meslek Yüksekokulu Yıllığı.* 2000;1:1. [CrossRef]
11. Akpir K. Türk Anestezi Tarihi. *Türk Anesteziyoloji Reanimasyon Derneği Dergisi.* 2012;40(1):1-25. [CrossRef]
12. Bilgin TE. Anestezide öncüler ve keşifler tarihi. *Lokman Hekim Journal,* 2013;3(2):37-52. [CrossRef]
13. Gümüş H, Çoraklı D. Türkiye'de Anesteziyoloji ve Reanimasyon'nun Nelişimi. Narkozdan Anesteziye. Bilgin H, Editor. Türkiye'de Anesteziyoloji ve Reanimasyon Biliminin Tarihsel Gelişimi. Bursa: TARD Yayınları; 2016;65-114.
14. Yıldırım N. Mekteb-i tıbbiye-I adliye-I şahanede 1891 yılında yapılan anesteziye ait bir mezuniyet tezi. *Tarih ve Toplum.* 1993;113:284-293. [CrossRef]
15. Anesteziyoloji ve Reanimasyon Anabilim Dalı ve Klinikleri. Bilgin H, Editor. Türkiye'de Anesteziyoloji ve Reanimasyon Biliminin Tarihsel Gelişimi-II. Bursa: TARD Yayınları; 2017;233-494. [CrossRef]

DOI: 10.4274/TJAR.2023.231479

Review Article
Perioperative Care

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):465-469

Gastric Ultrasound for Gastric Content Evaluation

Shubha Srinivasareddy

Penn State Milton S. Hershey Medical Center, Consultant in Anaesthesia and Chronic Pain, Pennsylvania, United States

Cite this article as: Srinivasareddy S. Gastric Ultrasound for Gastric Content Evaluation. *Turk J Anaesthesiol Reanim.* 2023;51(6):465-469.

Abstract

Gastric content aspiration occurs once every 2000-3000 general anaesthetics. It is associated with a 20% incidence of in-hospital mortality. The incidence of pulmonary aspiration in patients undergoing surgery is at least three times more, up to 1 in 895 general anaesthetics. Pulmonary aspiration indeed is associated with half of our airway-related mortality linked with anaesthesia. The pulmonary aspiration causes significant morbidity including respiratory failure, acute lung injury, and multi-organ failure in adults. This review study aims to compare the stomach volume and contents in patients following standard fasting guidelines by Point of care gastric ultrasound measurements. Perioperative gastric ultrasound is a developing diagnostic modality that is modest, easy, non-invasive and efficient. It is very helpful to determine gastric contents in adult, obese, paediatric, and obstetric patients. It is a dependable and replicable tool that can be used for effective anaesthetic management. Gastric ultrasound is an irreplaceable procedure to complement the use of fasting guidelines, particularly when these guidelines have not been followed, or may not be relevant. Further series of research with metanalysis is required to understand the influence of point-of-care gastric ultrasound assessment on perioperative outcomes.

Keywords: Gastric content, ultrasonography, preoperative fasting, residual gastric volume

Main Points

- Predictable pre-operative fasting status assessment.
- Performing successful gastric ultrasound study.
- Tips for optimal point of care ultrasound study.

Introduction

As a well-trained anaesthesiologist, we do good perioperative assessment and examination of a patient.[1] It is a chance to conduct a systematic survey of health systems and do a clinical examination, and to discuss any related issues of the procedure with the patient.[2] There should be a discussion about the necessities for fasting, and in the theatre waiting area. It is important to confirm the patient has fasted as per the guidelines and is adequately fasted.[3] Aspiration is associated with increased perioperative adverse outcomes with an increased gastric volume, acidity or particulate matter.[4] Drugs used during anaesthesia causes absent or reduced airway reflexes and risk of aspiration of gastric contents. We have seen studies which showed that 1 in 2000-3000 anaesthetised patients carry risk of aspiration.[5] Substantial morbidity and mortality occurs in 1:200 and 1 in 72,000-100,000 patients subsequently. Adverse events related to aspiration mainly occur during anaesthesia induction, but these events can occur during extubation and even intraoperatively.[6]

Corresponding author: Shubha Srinivasareddy, e-mail: sshubha83@yahoo.com

Received: November 22, 2023 Accepted: December 18, 2023

National Audit Project-4 revealed that in the hospitals in UK, aspiration was accountable for 50% of deaths and aspiration was the most common cause of death linked to airway complications.[7] In Australia, 30% of aspiration cases were admitted in high dependency unit and of those, 4% died according to the Australian Anaesthetic Incident Monitoring Study. Anaesthesia Closed Claims Project in the US suggested that 57% of cases aspirated and resulted in death and 14% in permanent disability.[8]

With the above statistically evidence, it is of consideration to the anaesthesiologist to know what to expect regarding the gastric content's nature and gastric emptying time. Gastric emptying time can be measured by various methods, namely paracetamol absorption, radiological studies, gastric ultrasound, and gastric aspirates.[9]

All the above study techniques are subjective assessment of gastric emptying time and gastric volume in fasted patients and they vary vastly from patient to patient. Peri-operative gastric ultrasound has emerged as a reliable tool for assessment of gastric contents as empty, clear fluid and solids, and when contents are clear fluid, to quantify the gastric volume.[10] Gastric ultrasound has been widely used in anaesthesia education and practice. It has been considered as a valid and reliable tool in a variety of patient populations like severely obese individuals, pregnant and non- pregnant adults as well as paediatric patients.[11]

Assessing and measuring gastric content, volume, and transit time is crucial. While numerous invasive methods exist, such as evaluating paracetamol absorption, utilizing electrical impedance tomography, employing radiolabeled diets, conducting polyethylene glycol dilution studies, or suctioning gastric content through tubes, these approaches are invasive, time-consuming, and are not utilized in perioperative practice.[12]

Anatomical Concepts

The stomach comprises five distinct parts: the cardia, fundus, body, antrum, and pylorus. Identifying the gastric antrum in the epigastric region through ultrasound is straightforward. Positioned as the most dependent section of the stomach, the gastric antrum facilitates the descent of gastric contents into this region.[13] The gastric antral wall is characterized by five discrete layers-mucosa, muscularis mucosae, submucosa, muscularis propria, and serosa. While these layers are not clearly visible on ultrasound, they are arranged from luminal to extra-luminal. The gastric antrum is situated posterior and inferior to the medial margin of the left lobe of the liver, anterior to the tail of the pancreas, and adjacent to the aorta.[14]

Acquisition of Images

Patient Positioning

The epigastric region needs should be fully exposed. Gastric antrum is located in both supine and right lateral decubitus (RLD) positions. Significant volumes of gastric content are easily observable in the gastric antrum, while smaller amounts may persist in the gastric fundus. The supine position, due to the greater dependency of the gastric fundus, makes it challenging to visualize its contents. In contrast, RLD position facilitates the gravitational drainage of gastric content toward the antrum.The RLD position increases the sensitivity of ultrasound to detect smaller volumes. Hence the best position to visualise and check antral content is RLD position. While some suggest conducting gastric sonography with the patient in a semi-recumbent position, this method is less precise than using RLD position for quantifying gastric volumes. Applying RLD positioning can be impractical for certain patients, such as those who are critically ill, experiencing trauma, or are pregnant. In such cases, scanning in the semi-recumbent position serves as a practical alternative (Table 1).

Table 1. Successful algorithm for a good POCUS study[21]

Patient	- Position supine and RLD - Adjust ambient light - Expose the upper abdomen	**Probe**	• Adults: low frequency curved probe • Paediatrics: consider high frequency linear probe • Acoustic medium: gel • Sagittal scanning plane in the epigastrium
Picture	Scanning technique	• Sweep widely from left to right subcostal margin to systematically identify the stomach as a hollow viscus located superficially between the left lobe of the liver and the pancreas with a prominent muscularis layer within its wall • Rock and slide to positively identify the antrum at the level of the aorta • Rotate to obtain a true cross section of the antrum avoiding oblique views • Heel to toe movement to optimize acoustic reflections	
	Knobology	Primary: adjust depth and gain Secondary: adjust tissue harmonics and focal zone Tertiary: colour or power Doppler to confirm vessel identity if required	

Transducer Criteria

It is essential to measure a good clinical surface area. A convex probe (1-5 MHz) transducer is used. Sufficient penetration of the abdominal compartment is required to produce good sonographic images of the key landmarks. With regards to low BMI and paediatric patients, a linear, high-frequency (5-12 MHz) probe can be used to provide better visualisation of the superficial antrum and surrounding structures.[15] The sonographic gel is applied on the probe to work as an acoustic medium. Changes in the depth and gain has to be performed according to individual patient body habitus to appropriately visualise the gastric contents.[15-17]

Ultrasound Imaging Technique

Ultrasound transducer is placed in a sagittal plane in the epigastric region, immediately below the xiphisternum to visualise the gastric antrum. Conventionally, the transducer orientation positions cephalad to the left of the screen. The ultrasound machine's probe is aligned vertically to the skin and is swept horizontally from the left costal margin to identify key sonographic landmarks in a sequence from deep to superficial. These include the vertebral bodies, abdominal aorta, head or neck of the pancreas, inferior margin of the left lobe of the liver, and the gastric antrum (Figure 1).[18] The gastric antrum is observed through the acoustic window formed by the liver, allowing differentiation from other hollow viscera like the duodenum or bowel. Identification is facilitated by the antrum's thick, hypoechoic muscularis layer, along with the hyperechoic serosa and mucosal layers, typically measuring 4 mm in thickness (Figure 1), and its superficial anatomical location. The antrum proves to be the most accessible part of the stomach for sonography, yet achieving a complete observation can be challenging due to the presence of air in the stomach body. Obtaining the optimal sonographic window may necessitate sliding the transducer from left to right or right to left to visualize the antrum in the short axis at the level of the aorta.[19] To minimize obliquity, maneuvers such as heel-to-toe movements or transducer rotation can be employed to obtain clear antral views.[20]

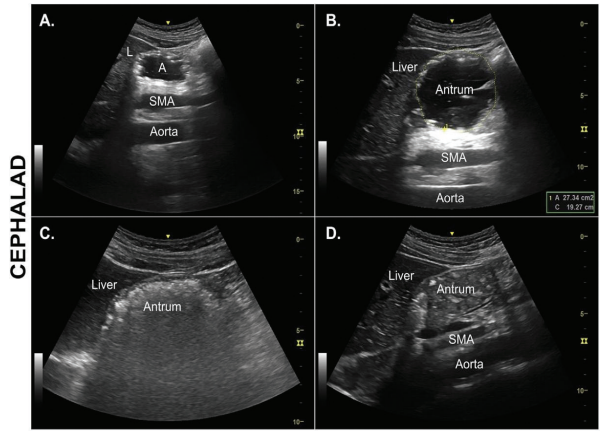

Figure 1. Ultrasound representation of gastric antrum.

Discussion

The concept of full stomach has been universally followed to protect against vomiting, regurgitation and aspiration during anaesthesia. However, stomach can never be completely empty, since it continues to secrete gastric fluid, even after overnight fasting. Studies have shown that prolonged fasting has been associated with reduced gastric pH due to increased gastric acid secretion and increase in gastric volume, placing the patients at risk category for aspiration. Prolonged fasting in preoperative period is known to increase the risk of dehydration, vomiting and anxiety.

Preoperative gastric fluid volume measurement done after the aspiration of gastric contents using Salem sump tube following ingestion of 150 mL of clear fluids 3 hrs before ambulatory surgery did not show any significant volumes. Hence it was concluded that healthy patients can be allowed to drink clear fluid until 3 hrs before surgery. Other techniques which have been traditionally used to assess the contents and volume of the stomach include paracetamol absorption, electrical impedance tomography, radio-labelled diet, polyethylene glycol dilution and imaging techniques like scintigraphy and MRI. These tools may not be used in the acute setting and with the advent of bedside gastric ultrasonography, the gastric contents and volume can be assessed easily in the perioperative period. Gastric ultrasonography has become an indispensable tool in anaesthetic practice and has been proven to be as reliable as gastric scintigraphy with Tc99m, which is considered the gold standard for the assessment of gastric volume.

Ultrasound has been the first non-invasive technique that provides both quantitative and qualitative information about the gastric contents and its volume. Numerous mathematical models have been devised to calculate gastric volume by utilizing ultrasonographic images of the gastric antrum and computing its cross-sectional area. Perlas et al.[15] introduced a precise linear model, derived from gastroscopic fluid assessment, demonstrating a mean difference of 6 mL between the predicted and measured volumes. It was applicable to adult, non-pregnant subjects with BMI up to 40 kg m^2 and can predict volume up to 500 mL. The ultrasonographic images were used to categorise the gastric antrum into 3 grades depending on the presence of liquids as grade 0 - empty antrum in both supine and RLD positions, grade 1 - presence of liquid in RLD only and grade 2 - presence of liquid in both RLD and supine positions. The images were recorded after overnight fasting and then 2 hrs after ingestion of 200 mL and 500 mL isotonic solution. The gastric antrum was easily identified,

once we located the left lobe of the liver and aortic/superior mesenteric artery pulsations.

Study Limitations

The ultrasonographic evaluation of gastric volume being a subjective assessment, the range of results depends upon the skill of the assessor. Hence there might be subjective variations in the results. Gastric emptying is also affected by pain, anxiety and use of preoperative medications. These criteria were not addressed and could be a limitation of the study.

Conclusion

Point of care gastric ultrasound proves invaluable in aligning with nil per oral guidelines, especially in situations where these guidelines may not have been adhered to or may not be suitable. However techniques should be improved to warranty better visualisation and assessment.

Tips for Optimal POCUS Study

The gastric antrum is found superficially posterior to the rectus muscle, immediately adjacent to the left lobe of the liver and anterior to the pancreas and great vessels (Figure 1).

The thoracic spine may be seen posterior to the great vessels, particularly in slim subjects or children.

Critical identifying features of the stomach, which can help differentiate it from other hollow viscus, are a multi-layered wall (though not all five layers are typically visualized with a curvilinear probe) and the consistent location adjacent to the liver edge with the great vessels, preferably the aorta, in the far field of the image.

Because peristalsis can dramatically change the antral size from second to second, it is important to view the antrum for at least 10-15 seconds to obtain a representative observation.

Peer-review: Internally peer-reviewed.

Funding: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Perlas A, Chan VW, Lupu CM, Mitsakakis N, Hanbidge A. Ultrasound assessment of gastric content and volume. *Anesthesiology.* 2009;111(1):82-89. [CrossRef]
2. Abdul Kadir MZ, Cheah SK, Mohamad Yusof A, Mohd Zaki F, Teo R. Ultrasound-determined residual gastric volume after clear-fluid ingestion in the paediatric population: still a debatable issue. *Children (Basel).* 2022;9(5):639. [CrossRef]
3. Sharma G, Jacob R, Mahankali S, Ravindra MN. Preoperative assessment of gastric contents and volume using bedside ultrasound in adult patients: A prospective, observational, correlation study. *Indian J Anaesth.* 2018;62(10):753-758. [CrossRef]
4. Mendelson CL. The aspiration of stomach contents into the lungs during obstetric anesthesia. *Am J Obstet Gynecol.* 1946;52:191-205. [CrossRef]
5. Roberts RB, Shirley MA. Reducing the risk of acid aspiration during cesarean section. *Anesth Analg.* 1974;53(6):859-868. [CrossRef]
6. Raidoo DM, Rocke DA, Brock-Utne JG, Marszalek A, Engelbrecht HE. Critical volume for pulmonary acid aspiration: reappraisal in a primate model. *Br J Anaesth.* 1990;65(2):248-250. [CrossRef]
7. Engelhardt T, Webster NR. Pulmonary aspiration of gastric contents in anaesthesia. *Br J Anaesth.* 1999;83(3):453-460. [CrossRef]
8. Bouvet L, Mazoit JX, Chassard D, Allaouchiche B, Boselli E, Benhamou D. Clinical assessment of the ultrasonographic measurement of antral area for estimating preoperative gastric content and volume. *Anesthesiology*. 2011;114(5):1086-1092. [CrossRef]
9. Weaver MK. Perioperative pulmonary aspiration in children: a review. *Pediatric Anesthesia.* 1993;3(6):333-338. [CrossRef]
10. Dongare PA, Bhaskar SB, Harsoor SS, et al. Perioperative fasting and feeding in adults, obstetric, paediatric and bariatric population: Practice Guidelines from the Indian Society of Anaesthesiologists. *Indian J Anaesth.* 2020;64(7):556-584. [CrossRef]
11. Green SM, Leroy PL, Roback MG, et al. An international multidisciplinary consensus statement on fasting before procedural sedation in adults and children *Anaesthesia.* 2020;75(3):374-385. [Erratum in: Correction. 2020 Jun;75(6):818]. [CrossRef]
12. Smith I, Kranke P, Murat I, et al. Perioperative fasting in adults and children: guidelines from the European Society of Anaesthesiology. *Eur J Anaesthesiol.* 2011;28(8):556-569. [CrossRef]
13. Sharma S, Deo AS, Raman P. Effectiveness of standard fasting guidelines as assessed by gastric ultrasound examination: A clinical audit. *Indian J Anaesth.* 2018;62(10):747-752. [CrossRef]
14. Patil MC, Dhulkhed PV, Prajwal B. Ultrasonographic estimation of gastric volume in patients after overnight fasting and after ingestion of clear fluids two hours before surgery. *Anaesthesia, Pain & Intensive Care.* 2020;24(3):308-313. [CrossRef]
15. Perlas A, Mitsakakis N, Liu L, et al. Validation of a mathematical model for ultrasound assessment of gastric volume by gastroscopic examination. *Anesth Analg.* 2013;116(2):357-363. [CrossRef]
16. Brady MC, Kinn S, Stuart P, Ness V. Preoperative fasting for adults to prevent perioperative complications. *Cochrane Database Syst Rev.* 2003:(4):CD004423. [CrossRef]
17. Ajuzieogu OV, Amucheazi AO, Nwagha UI, Ezike HA, Luka SK, Abam DS. Effect of routine preoperative fasting on residual gastric volume and acid in patients undergoing myomectomy. *Niger J Clin Pract.* 2016;19(6):816-820. [CrossRef]

18. Scarr M, Maltby JR, Jani K, Sutherland LR. Volume and acidity of residual gastric fluid after oral fluid ingestion before elective ambulatory surgery. CMAJ. 1989;141(11):1151-1154. [CrossRef]
19. Borland LM, Sereika SM, Woelfel SK, et al. Pulmonary aspiration in pediatric patients during general anesthesia: incidence and outcome. *J Clin Anesth.* 1998;10(2):95-102. [CrossRef]
20. Cubillos J, Tse C, Chan VW, Perlas A. Bedside ultrasound assessment of gastric content: an observational study. *Can J Anaesth.* 2012;59(4):416-423. [CrossRef]
21. El-Boghdadly K, Wojcikiewicz T, Perlas A. Perioperative point-of-care gastric ultrasound. *BJA Educ*. 2019;19(7):219-226. [CrossRef]

DOI: 10.4274/TJAR.2023.231277

Original Article
Regional Anaesthesia

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):470-476

Comparison of Two Different Positions for Ultrasound-Guided Intervertebral Distance Evaluation

Feyza Aksu[1], Ferda Kartufan[2], Özge Köner[1], Ayşegül Görmez[3], Elif Çiğdem Keleş[4]

[1]Yeditepe University Faculty of Medicine, Department of Anaesthesiology and Intensive Care, İstanbul, Turkey
[2]İstinye University Faculty of Medicine, Department of Anaesthesiology, İstanbul, Turkey
[3]Yeditepe University Faculty of Medicine, Department of Radiology, İstanbul, Turkey
[4]Yeditepe University Faculty of Medicine, Department of Biostatistics, İstanbul, Turkey

Cite this article as: Aksu F, Kartufan F, Köner Ö, Görmez A, Keleş EÇ. Comparison of Two Different Positions for Ultrasound-Guided Intervertebral Distance Evaluation. *Turk J Anaesthesiol Reanim.* 2023;51(6):470-476.

Abstract

Objective: During neuraxial anaesthesia, correct patient positioning is key for increased block success and (patient) comfort. The aim of this prospective study was to compare the lateral fetal decubitus (LFD) position with the sitting fetal lotus (SFL) regarding interspinous distance, transverse diameters of paravertebral muscles measured with ultrasonography, and patient comfort.

Methods: Fifty adult participants who could sit cross-legged and had no lumbar anomalies were included in our prospective study. In both SFL and LFD positions, measurements were performed with ultrasonography; in the axial plane, interspinous distance at the level of L4-L5, in the sagittal plan, with the probe slightly tilted, subcutaneous tissue-spinous process depth, and transverse diameters of paravertebral muscles were measured. Stretcher, waist position, and abdominal comfort were scored on a scale of 1 (very bad) to 7 (perfect) with a verbal numeric satisfaction scale.

Results: Interspinous distance was significantly larger in the SFL position than in the LFD position ($P < 0.05$). There was no significant difference between the two positions ($P > 0.05$) regarding patient comfort. Paravertebral muscle diameters were significantly broader in the SFL position than in the LFD position. The diameter of the left paravertebral muscle in the SFL position (45.8±8.8 mm) was larger than that in the LFD position (43±7.8 mm; $P < 0.001$). The diameter of the right paravertebral muscle in the SFL position was (47±9 mm) larger than that in the LFD position (43.4±7.6 mm; $P < 0.001$).

Conclusion: Although there was no difference regarding the comfort between the two positions, the interspinous distance was larger in the SFL position than in the LFD position.

Keywords: Anatomy, lumbar intervertebral distance, neuraxial anaesthesia, patient position, ultrasonography

Main Points

- Interspinous distance measured with ultrasonography at the lumbar 4th and 5th vertebral level has been shown to be significantly wider in the sitting fetal lotus position than in the lateral fetal decubitus position.
- There was no difference between the two positions in terms of patient comfort.
- Paravertebral muscle width is more relaxed in the sitting fetal lotus position than in the lateral fetal decubitus position.

Corresponding author: Feyza Aksu, e-mail: drfeyzaksu@gmail.com

Received: March 23, 2023 Accepted: October 05, 2023

Introduction

Although neuraxial anaesthesia techniques have been shown to be highly reliable, failed and inadequate blockage is worrying for both anaesthesiologists and patients and can turn the advantages of regional anaesthesia into disadvantages.[1] The failure rate of neuraxial block is around 2-20%.[2] Identifying the preventable causes of failure is critical for the accuracy of implementation and patient safety. Body structure, spinal anatomy, unidentified anatomical landmarks, excess body weight (body mass index ≥30 kg m^2), inappropriate patient position, intervention method, experience of the anaesthesiologist, and equipment are considered as the reasons for failure.[1]

Ultrasonography (USG) was introduced into clinical practice in the 90s to guide neuraxial block before or during the procedure.[3] Following the development of technology, USG image quality has improved, and its use during neuroaxial block has gained popularity. New USG devices provide better visualization of the bone structure surrounding the spinal canal. A meta-analysis has proven the increased intervention success of neuraxial anaesthesia performed using USG.[4]

Correct position, comfort of the patient, and sufficient interspinous space are essential for successful neuraxial implementation; therefore, different positions such as sitting fetal position, lateral decubitus fetus position, sitting fetal holding ball on lap position, sitting fetal semi-calf flexion position, 30% angle table position, modified sitting position, Oxford position, and cross-leg position have been described.[5-9]

In our study, we compared the lateral fetal decubitus (LFD) position with "sitting fetal lotus (SFL) position" in terms of interspinous distance (ISD) and depth of anatomical structures measured at L4-5 intervertebral space by USG and in terms of patient comfort. We hypothesized that the SFL position is superior to the frequently used LFD position in terms of interspinous distance and patient comfort.

Methods

This study was approved by the Yeditepe University Clinical Research Ethics Committee (date: 02.01.2019, approval no: KAEK: 923). The research was recorded with the ID number NCT03889223 at ClinicalTrails.gov protocol registration and results system-PRS U.S. National Library of Medicine Ultrasonographic assessments and satisfaction surveys for 50 volunteers were conducted after informed consent was obtained between March 20, 2019 and June 25, 2019.

Fifty healthy adult volunteers (older than 18 years-old) who had no lumbar anomaly, had not undergone lumbar regional surgery, and could sit cross-legged were included in our study. Demographic data of the participants, such as gender, age, height, body weight, and body mass index, were recorded. Volunteers were evaluated in the same room by the same radiologist using the same USG device [General Electric LOGIQ E9 (CISPR11 Group 1 Class A), Wauwatosa, WI, USA, 53226) and probe (9L-linear, probe 2.4-10 MHz)].

Participants were first placed in the LFD position. In the LFD position, participants were laid in the left lateral decubitus position, with the back toward the radiologist, their chins leaned to their chest, and their knees and hips were flexed thoroughly (Figure 1). The right and left crista iliaca were palpated, and the line connecting the posterior superior iliac wings of both crista iliaca in the horizontal plane was determined as the Tuffier line. Measurements with ultrasound were performed at the L4-L5 intervertebral space on the Tuffier line. After applying the hydrophilic anti-allergic USG gel, the area from the sacrum to the Tuffier line was examined in the longitudinal sagittal plane. The thickness of subcutaneous tissue (ST), skin to spinous process (S-SP) depth, and transverse diameters of the right and left paravertebral muscles were measured with USG in the axial plane at the level of the L4-L5 interspinous space. The interspinous distance was measured at the L4-L5 level in the same position.

Afterwards, the participants were placed in a SFL position with their legs crossed, their back turned toward the radiologist, their chin leaned to the chest and arms rested on the knees, and then asked to hunch their back (Figures 2a, 2b). As with the LFD position, the Tuffier line is identified in the SFL position as well. The area from the sacrum to the Tuffier line was examined in the longitudinal sagittal plan. The transverse diameters of the bilateral paravertebral muscles, interspinous distance at the L4–L5 level, thickness of subcutaneous tissue, and depth from the subcutaneous tissue to spinous processes were measured in the axial

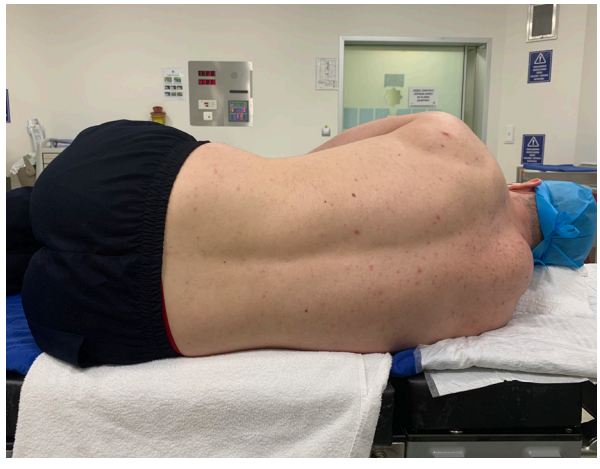

Figure 1. Lateral fetal decubitus position

plane with the probe slightly inclined. The interspinous distance was also measured at the L4-L5 level in the same position. USG measurements were recorded in millimeters. Ultrasonographic images of the lumber region are shown in Figures 3a and 3b.

After the USG evaluation was completed, participants were asked to rate their position experience using a 7-point Likert numerical comfort assessment questionnaire.[10] The stretcher comfort, position comfort, waist comfort, and abdominal comfort were scored as 1 (very bad) - 7 (perfect) for both positions.

Figure 2a. Sitting fetal lotus position, lateral view.

Figure 2b. Sitting fetal lotus position, posterior view.

Statistical Analysis

Eighteen participants were required to confirm a 20% change in interspinous difference based on a preliminary evaluation between the groups (1-β=0.9; alpha=0.05). However, at least 48 participants were required to compare the comfort with a 7-point Likert numerical assessment questionnaire. Neuraxial anaesthesia is applied to

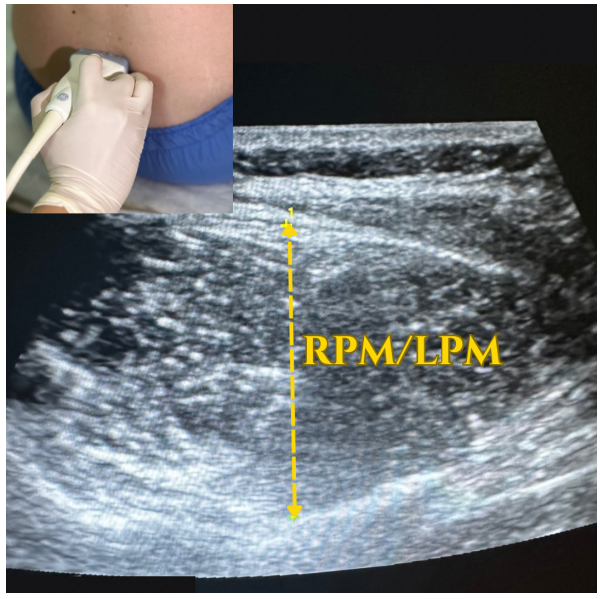

Figure 3a. USG image of examined lumber vertebral region.

USG, ultrasonography; RPM, right paraspinal muscle; LPM, left paraspinal muscle.

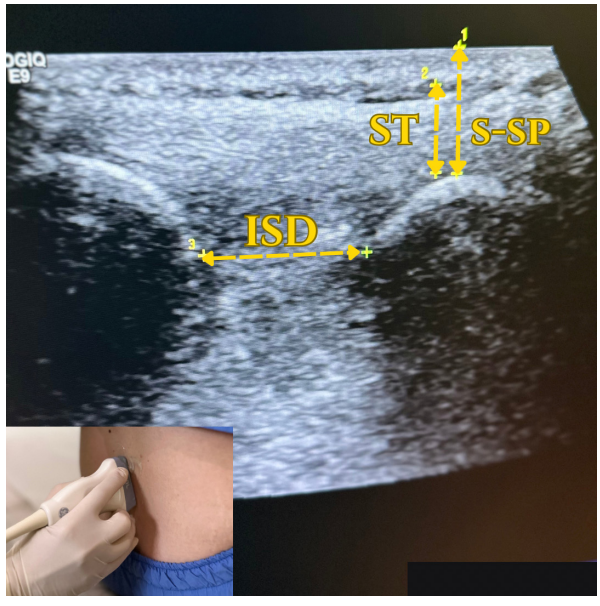

Figure 3b. Enlarged lumber vertebral USG view.

USG, ultrasonography; ISD, interspinous distance; ST, subcutaneous tissue; S-SP, skin to spinous process.

approximately 600 patients per year in our hospital, and the number of samples required to reflect this population was found to be a minimum of 235 with the corresponding table of reliability level of 95%. The frequency range is accepted as 3 and from the 150-person volunteer pool, 50 people were chosen as being the 1st, 4th, 7th, 10th...[11] Volunteers were given a code, and informed consent was obtained. The data are reported as the mean (standard deviation) and minimum-maximum. The distribution of variables was evaluated using the coefficient of variation, skewness-kurtosis, normality test of Shapiro-Wilk, and histogram. Parametric tests were used for the analysis of data with normal distribution. Student's t-test and Wilcoxon test were used in dependent samples to compare the USG data of the two positions. The t-test and Mann-Whitney U test were used in independent samples to compare the sonographic results of the two positions by gender. In addition, the Mann-Whitney U test was used to compare differences in USG measurements from a gender perspective. The marginal homogeneity test was used to evaluate the 7-point comfort survey, and the chi-square test (Fisher's Exact test applied as being Monte Carlo confidence level 95%) was used to analyze the comfort change in relation to gender-based positioning techniques. IBM statistic packages for the social sciences 22.0 program (IBM SPSS Corp; Armonk, USA) were used for analysis. A "*P*" value less than 0.05 was considered statistically significant.

Results

Demographic data of 50 volunteers are presented in Table 1.

The average ST and S-SP measured in the SFL position were significantly shorter than those measured in the LFD position. The subcutaneous tissue thickness was 8.8±5 mm in the SFL position, whereas 9.8±5.2 mm in the LFD position ($P < 0.001$). The skin to spinous process distance was 11±5.2 mm in the SFL position and 12±5.5 mm in the LFD position ($P < 0.001$; Table 2).

The left and right paravertebral muscle diameters were significantly broader in the SFL position than in the LFD position. The diameter of the left paravertebral muscle in the SFL position (45.80±8.82 mm) was larger than that in the LFD position (43.04±7.68 mm; $P < 0.001$). The diameter of the right paravertebral muscle in the SFL position was (47±9 mm) larger than that in the LFD position (43.4±7.6 mm; $P < 0.001$). The diameter of the mean paravertebral muscle was broader in the SFL position (46.5±9) than in the LFD position (43±7.6; $P < 0.001$) as well. The interspinous distance was significantly larger (17.5±2 mm) in the SFL than in the LFD (14.7±2 mm; $P < 0.001$) position (Table 2).

When differences between LFD and SFL positions were compared according to gender, no significant difference was observed in terms of ST (*P*=0.092), S-SP (*P*=0.271), mean paravertebral muscle (*P*=0.080), and interspinous distance (*P*=0.694; Table 3).

According to the seven-point Likert comfort evaluation scale, there was no significant difference between the two positions in terms of stretcher comfort (5.9±1.3 vs 5.8±1.3, in LFD and SFL positions; respectively, *P*=0.599), position comfort (5.2±1.6 vs 5.4±1.4, in LFD and SFL positions; respectively,

Table 1. Demographic Data of Volunteers

n = 50		Mean±SD
Age; years	F (n = 25)	38±8.4
	M (n = 25)	35±9
	Total	36±8.8
Body weight; kg	F (n = 25)	64±13
	M (n = 25)	80±8.6
	Total	72±13.5
Height; cm	F (n = 25)	164±6
	M (n = 25)	177±6.6
	Total	170±9
BMI; kg m^2	F (n = 25)	24±4.8
	M (n = 25)	26±3
	Total	25±4

n, number of volunteers; SD, standard deviation; kg, kilogram; cm, centimeter; BMI, body mass index; F, female; M, male.

Table 2. Ultrasonography Measurements of the Volunteers

		Mean±SD (n = 50)	Min.-Max.	*P* value
Subcutaneous tissue (ST) (mm)	LFD	10±5	2-27	0.0001[w]
	SFL	9±5	2-27	
Skin to spinous process (S-SP) (mm)	LFD	12±5.6	3.5-31	0.0001[w]
	SFL	11±5	3.5-30	
Left paraspinal muscle (LPM) (mm)	LFD	43±7.7	28-58	0.0001[t]
	SFL	46±8.8	25-65	
Right paraspinal muscle (RPM) (mm)	LFD	43±7.7	28-59	0.0001[t]
	SFL	47±9	26-70	
Mean paraspinal muscle (MPM) (mm)	LFD	43±7.6	28-58.5	0.0001[t]
	SFL	46±9	25.5-67.5	
Interspinous distance (ISD) (mm)	LFD	14.8±2	11-21	0.0001[t]
	SFL	17.5±2	13-23	

SD, standard deviation; Min.-Max., minimum-maximum; LDF, lateral fetal decubitus position; SFL, sitting fetal lotus position; mm, millimeter; [w], Wilcoxon test; [t], paired t-test.

Table 3. Ultrasonography Measurements of Difference Between SFL and LFD Positions According to Gender

SFL-LDF difference (mm)	Male (n = 25) Mean±SD	Female (n = 25) Mean±SD	P^{m}
ST	-1.2±1	-1±1.4	0.092
S-SP	-1.2±0.8	-1±1	0.271
MPM	2.6±2.8	3.8±3.2	0.080
ISD	2.7±1.3	2.7±2.3	0.694

SD, standard deviation; ST, subcutaneous tissue; S-SP, skin to spinous process; LFD, lateral fetal decubitus; SFL, sitting fetal lotus; MPM, mean of bilateral paraspinal muscles; ISD, Interspinous distance; ^{m}, Mann Whitney U.

P=0.490), abdomen comfort (5±1.6 vs 5.5±1.3, in LFD and SFL positions; respectively, *P*=0.135), and lumbar comfort (5.3±1.5 vs 5.4±1.3, in LFD and SFL positions; respectively, *P*=0.631) (Table 4).

Table 4. 7-point Likert Comfort Score Comparison

Positions n = 0		Mean±SD	Min.-Max.	P^{M-h}
Strechter comfort	LFD	5.9±1.3	1-7	0.599
	SFL	5.8±1.3	3-7	
Position comfort	LFD	5.2±1.6	1-7	0.490
	SFL	5.4±1.4	3-7	
Lumbar comfort	LFD	5.3±1.5	1-7	0.631
	SFL	5.4±1.3	2-7	
Abdominal comfort	LFD	5±1.6	1-7	0.135
	SFL	5.5±1.3	2-7	

Min.-Max., Minimum-Maximum; SD, standard deviation; LDF, lateral fetal decubitus position; SFL, sitting fetal lotus position; $^{M-h}$, Marginal homogeneity test.

Discussion

The SFL position is advantageous regarding USG-based measurements compared to the LFD position. The interspinous distance is significantly wider in the SFL position than in the LFD position. There was no significant difference between the two positions in terms of patient comfort.

Neuroaxial anaesthesia is performed in three main positions (sitting position, lateral decubitus position, prone position). However, other modified positions (modified sitting position, mid-calf position, holding the ball on the lap position, angled table position, Oxford position, cross-leg position) have also been described. As far as we know, there are only two studies in which patients were placed in the sitting lotus position. In one of the aforementioned studies, patients were in the sitting lotus position and holding a pillow on their lap.[6,9] In a previous study performed by us, patients were placed in the SFL position; however, patients' arms were rested on their knees.[12]

There was no difference in spinal anaesthesia success between frequently used lateral decubitus fetal and conventional sitting positions.[13] In their study, Manggala et al.[8] could not find a difference between the crossed-leg sitting position, which resembles our SFL position the most, and the conventional sitting position in terms of spinal anaesthesia success. In the aforementioned study, the comfort of the position was not evaluated. In our study, all the participants were given both positions consequently. Therefore, they were able to compare the comfort of both positions.

Successful neuroaxial anaesthesia intervention can be achieved with an adequate interspinous distance and appropriate patient position.[14] Positioning the patient properly and maintaining the position by keeping the patient comfortable will help the ISD to remain unchanged, thus increasing the chance of success of neuroaxial anaesthesia.[14]

Meta-analysis[4,15] has shown that the use of USG significantly improves the success and effectiveness of neuroaxial anaesthesia. Besides USG, there are other imaging methods such as magnetic resonance imaging, fluoroscopy, and computed tomography to measure interspinous distance and other surrounding tissues, but USG is noninvasive and easily accessible.

The reliability of USG is associated with the clinical experience of the researcher. USG can better demonstrate anatomical signs and measurements of the anatomy of the spine in the hands of a skilled and experienced specialist, even if the patient is obese and pregnant.[16,17] Therefore, an expert radiologist performed the evaluation using USG.

The only study in the literature comparing the comfort of neuroaxial positions is by Dimaculangan et al.[6] In their study, the authors compared six different positions for ISD with sonography and comfort with a 10-point VAS score and found interspinous distance wider in the "sitting fetal position" than in other sitting positions. In our study, the interspinous distance measured at the level of L4-5 vertebrae was significantly wider in the SFL position than in the LFD position. Furthermore, the sitting fetal position is more comfortable than the conventional sitting position.[6] In the authors' study[6] the sitting fetal position was different from our SFL position; the subjects sat on the side of an OR table, thighs on the table with legs hanging freely over the table's edge, arms resting on their legs with the back curved. In their study, Dimaculangan et al.[6] found the sitting fetal position, with legs hanging freely over the table's age, as the 3rd most comfortable position after the sitting position holding a ball on the lap and lateral decubitus position.

In our study, ST and S-SP measurements were also significantly shorter in favor of the SFL position. In a previous study, we showed that enlarged paraspinal muscle diameter was correlated with increased patient comfort.[12] To the best of our knowledge, no other studies have shown the correlation between paraspinal muscle relaxation and patient comfort before our aforementioned study. Further relaxation of the paraspinal muscles in the SFL position may help reduce pain in injection interventions during epidural and spinal anaesthesia; therefore, patient comfort might be better during the procedure. This can both increase patient compatibility and facilitate the procedure by providing better stabilization. Consequently, it can help perform a more successful neuroaxial block. In our current study, transverse diameters of paraspinal muscles measured using USG revealed a significant increase in favor of the SFL position. However, this finding has not yielded better comfort in favor of the SFL position. In our study, a 7-point Likert comfort score was used to compare the volunteers' comfort in the LFD and SFL positions. The SFL position was superior to the LFD position in all parameters measured by USG. However, there was no statistical difference between the two positions regarding comfort. An explanation for this situation might be that the participants feared falling from the stretcher because they were seated parallel to the long edge and in the middle of the stretcher. However, patients sat cross-legged perpendicular to the short axis of the OR table in the SFL position; therefore, there was a perceived or actual risk of falling.

There were no significant differences between the genders in terms of USG measurements. Therefore, the SFL position can be used in both genders. Shorter ST and S-SP distances provided with the SFL position suggest that this position may be beneficial in obese and pregnant patients compared with the LFD position.

Study Limitations

This study has some limitations. The SFL position was not compared with other traditional positioning techniques in terms of neuroaxial block success rate. In this study, morbidly obese and elderly patients were not included. However, no other studies have compared paraspinal muscle measurements with USG and evaluated patient comfort using the 7-point Likert comfort scale.

Conclusion

Although no difference was found in terms of patient comfort between the two positions, SFL is advantageous in USG measurements compared with the LFD position. The interspinous distance is significantly wider in the SFL position than in the LFD position. Despite not being evaluated in this study, it may be suggested that the SFL position may increase the success of neuroaxial block. Considering these findings, we believe that the future studies should evaluate the reliability and success of the SFL position during neuroaxial block.

Ethics

Ethics Committee Approval: This study was approved by the Yeditepe University Clinical Research Ethics Committee (date: 02.01.2019, approval no: KAEK: 923).

Informed Consent: Satisfaction surveys for 50 volunteers were conducted after informed consent was obtained between March 20, 2019 and June 25, 2019.

Peer-review: Externally and internally peer-reviewed.

Author Contributions: Concept - FA., F.K.; Design - F.A., F.K.; Supervision - F.K., Ö.K.; Data Collection or Processing - FA., F.K., A.G.; Analysis or Interpretation - F.K., Ö.K., A.G.; Literature Search - FA., Ö.K., A.G.; Writing - F.A., A.G.; Critical Review - A.G.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Fettes PD, Jansson JR, Wildsmith JA. Failed spinal anaesthesia: mechanisms, management, and prevention. *Br J Anaesth*. 2009;102(6):739-748. [CrossRef]
2. Perna P, Gioia A, Ragazzi R, Volta CA, Innamorato M. Can pre-procedure neuroaxial ultrasound improve the identification of the potential epidural space when compared with anatomical landmarks? A prospective randomized study. *Minerva Anestesiol*. 2017;83(1):41-49. [CrossRef]
3. Hadzic A. Hadzic's Textbook of Regional Anesthesia and Acute Pain Management, Second Edition. New York: McGraw-Hill Education, 2017:318-445. [CrossRef]
4. Perlas A, Chaparro LE, Chin KJ. Lumbar neuraxial ultrasound for spinal and epidural anesthesia: a systematic review and meta-analysis. *Reg Anesth Pain Med*. 2016;41(2):251-260. [CrossRef]
5. Schultz JR, Njaa MD, Spahn T, Auyong DB, Habib AS, Panni MK. Mid-calf position--an improved technique to place neuraxial anaesthesia. *Br J Anaesth*. 2006;97(4):583-584. [CrossRef]
6. Dimaculangan DP, Mazer JA, Maracaja-Neto LF. Sonographic evaluation of lumbar interlaminar space opening in a variety of patient body positions for optimal neuraxial anesthesia delivery. *J Clin Anesth*. 2016;34:159-165. [CrossRef]
7. Baigmohammadi MT, Khan ZH. Modified sitting position: a new position for spinal anesthesia. *Anesth Analg*. 2007;105:549. [CrossRef]
8. Manggala SK, Tantri AR, Satoto D. Comparison of Successful Spinal Needle Placement Between Crossed-Leg Sitting Position and Traditional Sitting Position in Patients Undergoing Urology Surgery. *Anesth Pain Med*. 2016;6(4):e39314. [CrossRef]

9. Stoneham MD, Eldridge J, Popat M, Russell R. Oxford positioning technique improves haemodynamic stability and predictability of block height of spinal anaesthesia for elective caesarean section. *Int J Obstet Anesth*. 1999;8(4):242-248. [CrossRef]
10. Alver S, Bahadir C, Tahta AC, et al. The efficacy of ultrasound-guided anterior quadratus lumborum block for pain management following lumbar spinal surgery: a randomized controlled trial. *BMC Anesthesiol*. 2022;22(1):394. [CrossRef]
11. Krejcie RV, Morgan DW. Determining sample size for research activities. *Educ Psychol Meas*. 1970;30(3):607-610. [CrossRef]
12. Kartufan FF, Karatay E, Kızılcık N, Köner Ö. The 'Cross-legged foetal sitting neuraxial position': is it beneficial?-a prospective randomised clinical trial via ultrasonography. *Turk J Anaesthesiol Reanim*. 2020;48(5):371-378. [CrossRef]
13. Prakash S, Chaudhary K, Gogia AR, Chellani H, Salhan S, Singh R. A prospective, randomized controlled trial comparing the left lateral, modified lateral and sitting positions for spinal block characteristics for Cesarean delivery. *Minerva Anestesiol*. 2013;79(6):652-660. [CrossRef]
14. Shankar H, Rajput K, Murugiah K. Correlation between spinous process dimensions and ease of spinal anaesthesia. *Indian J Anaesth*. 2012;56(3):250-254. [CrossRef]
15. Shaikh F, Brzezinski J, Alexander S, et al. Ultrasound Imaging for Lumbar Punctures and Epidural Catheterizations. *Obstetric Anesthesia Digest*. 2014;34(2):71-72. [CrossRef]
16. Kallidaikurichi Srinivasan K, Iohom G, Loughnane F, Lee PJ. Conventional landmark-guided midline versus preprocedure ultrasound-guided paramedian techniques in spinal anesthesia. *Anesth Analg*. 2015;121(4):1089-1096. [CrossRef]
17. Locks Gde F, Almeida MC, Pereira AA. Use of the ultrasound to determine the level of lumbar puncture in pregnant women. *Rev Bras Anestesiol*. 2010;60(1):13-19. [CrossRef]

DOI: 10.4274/TJAR.2023.231328

Original Article

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):477-484

Duties of Anaesthetists and Assessment of Awareness, Concerns, and Expectations on Anaesthesia Practices

Melahat Yalçın Solak[1], Murat İzgi[1], Murat Tümer[2], Şennur Uzun[1]

[1]Clinic of Anaesthesiology and Reanimation, Hacettepe University Hospital, Ankara, Turkey
[2]Clinic of Anaesthesiology and Reanimation, American Hospital, İstanbul, Turkey

Cite this article as: Yalçın Solak M, İzgi M, Tümer M, Uzun Ş. Duties of Anaesthetists and Assessment of Awareness, Concerns, and Expectations on Anaesthesia Practices. *Turk J Anaesthesiol Reanim.* 2023;51(6):477-484.

Abstract

Objective: Numerous studies performed worldwide indicate that the public has limited knowledge of anaesthesia practices and anaesthetists' duties and responsibilities. This study aimed to identify the level of knowledge about anaesthetists and anaesthesia practices, and to assess the reasons for anxiety about anaesthesia of the population admitted to our hospital, which is tertiary in Turkey. The secondary aim was to analyze their differences according to sex, education level, and acquired anaesthesia experience.

Methods: A survey comprising 23 questions was administered to 400 patients and/or their relatives, aged 18-85 years, who presented to our clinic for preoperative anaesthesia evaluation and for whom elective surgery was planned from March through October 2017.

Results: Of the 400 participants, 213 were women and 187 were men. Of all participants in the survey, 51.2% were patients and 48.8% were patient relatives; 64.2% had anaesthesia experience and 35.8% had never had anaesthesia before. The survey group's level of knowledge about anaesthesia was generally low. According to education level, there was a statistically significant difference in the anaesthesia recognition level. However, the acquired anaesthesia experience did not affect the anaesthesia recognition level.

Conclusion: To raise the level of knowledge about this topic, anaesthetists must provide patients with more detailed information during preoperative and postoperative visits, which would significantly reduce their anxiety levels. Further, we determined that increasing the use of methods such as media-based brochures, booklets, and videos to inform patients may increase knowledge levels and reduce anxiety levels.

Keywords: Anaesthesia, anxiety, knowledge

Main Points

- Numerous studies performed worldwide indicate that the public has limited knowledge of anaesthesia practices and anaesthetists' duties and responsibilities. In this study, we aimed at our hospital population's knowledge and anxiety levels.
- The survey group's level of knowledge was generally low. According to education level, there was a statistically significant difference in the anaesthesia recognition level. However, the acquired anaesthesia experience didn't affect it.
- We determined that increasing preoperative and postoperative visits to inform patients and using media-based items may have a role in increasing patients' knowledge levels and reducing their anxiety levels.

Corresponding author: Melahat Yalçın Solak, e-mail: melosyalcin@gmail.com

Received: May 17, 2023 Accepted: November 15, 2023

Introduction

Developments in the area of anaesthesia contribute to successful surgical outcomes at a growing rate.[1] However, the roles played by anaesthetists in the operating room (OR) and the responsibilities that they share with the surgeon are not known.[2] Although anaesthetists have several duties such as resuscitation, intensive care, and acute and chronic pain management, in addition to their duties in the OR, several studies performed across the world show that society has limited knowledge about anaesthesia practices and anaesthetists' duties and responsibilities. The level of knowledge about this topic varies according to certain factors such as socioeconomic status, education level, age, sex, and anaesthesia experience.[3-10] The patient's limited level of knowledge about anaesthesia increases anxiety, which adversely affects the perioperative period and postoperative recovery.[9,11]

Through a survey administered to the patients and/or their relatives who were admitted to our hospital for elective surgery, we aimed to evaluate a part of Turkish society's level of knowledge about anaesthesia and anaesthetists, to determine the reasons for anxiety, and to compare the differences in knowledge and anxiety according to sex, education level, and acquired anaesthesia experience, to identify inaccurate or missing knowledge about the topic, and determine what anaesthetists should do about this topic.

Methods

Ethical approval for this study (approval no: GO 17/113-27) was provided by the Non-Invasive Clinical Research Local Ethics Committee of Hacettepe University, Ankara, Turkey on February 28th, 2017.

The research participants were patients and/or their relatives, aged 18-85 years, who were admitted to the anaesthesia clinic in Hacettepe University Hospital between March and October 2017 for preoperative anaesthesia assessments, agreed to participate in the survey, and knew Turkish.

Patients and/or patient relatives who had a brain injury, speech and hearing disorders, a previously diagnosed serious psychiatric problem, or a serious illness that would affect the general health condition were excluded from the study. A total of 400 patients and/or patient relatives were included in the study.

The survey form contained 23 questions, which were presented in two parts. The first part of the survey addressed demographic data such as age, sex, and education level, and the second part contained questions about anaesthetists' duties, workplaces, anaesthesia methods, and reasons for having anaesthesia-related fear and anxiety.

After the patients and/or their relatives consented to participate in the study upon being informed about the survey by the anaesthetist, they were asked to complete the survey form. The survey was administered verbally to participants and/or patient relatives who were illiterate and their verbal responses were recorded.

Statistical Analysis

Statistical analysis of the research data was conducted using the Statistical Package for the Social Sciences (SPSS) ver. 20.0 software package. Whether the research data were normally distributed was checked using the Shapiro-Wilk test. Numerical variables that were normally distributed are expressed as "mean ± standard deviation". Categorical variables are presented as numbers and percentages. In the case of numerical variables with a normal distribution, the independent samples t-test was used to compare the two groups. The chi-square test, Yates's correction for continuity, and Fisher's exact test were used to compare categorical data. Statistical significance was identified if the *P* value was lower than 0.05 ($P < 0.05$).

Results

The study population comprised 400 patients/relatives. Two hundred thirteen were female (53.3%) and 187 were male (46.7%). The demographic data of the research participants are presented in Table 1.

Of our study population, 51.2% were patients and 48.8% were patient relatives, 68% had anaesthesia experience, and 32% had never had anaesthesia before. Three-quarters (76.5%) of the participants answered the question "Who do you think performs the anaesthesia in surgery?" as an

Table 1. Demographic Characteristics

Variable	Frequency (n)	Percentage (%)
Sex		
Female	213	53.3
Male	187	46.7
Age		
30 years or below	97	24.2
31-39 years	99	24.8
40-51 years	99	24.8
52 years above	105	26.2
Education Level		
Primary school or below	110	27.5
Secondary school	42	10.5
High school	122	30.5
College/University	126	31.5
Total	400	100.0

Categorical variables are expressed as "number (%)," and numerical variables are expressed as "mean ± standard deviation".

anaesthesiologist, 12.5% answered it as "I do not know." The majority of the participants (69%) answered the question "Who is the anaesthesiologist?" as "A specialist physician who graduated from medical school and received anaesthesia training;" the rate of those who answered saying "I don't know" was 24.5%. Of all the participant patients/relatives, 85% knew about general anaesthesia, 63.8% knew about local anaesthesia, and 61% knew about regional anaesthesia from among the anaesthesia methods. Female participants had a higher percentage of knowledge of regional anaesthesia than male participants and this difference was statistically significant (67.6% vs. 53.5%, P=0.004). For the question about anaesthetist's duties in the perioperative process, 77.3% of the participants said "Anaesthetist follows up the patient's sleep and wakefulness, that is, the patient's state of consciousness." In the framework of the question about the anaesthetist's duties outside the operation room, 36.5% of the participants said, "Anaesthetists work in intensive care units (ICUs) called reanimation," and only 29.5% of the participants responded, "Anaesthetists take part in the treatment of a variety of pains in particular cancer pain." The answers to these questions did not differ significantly in terms of sex (Table 2).

Table 2. Knowledge Level of Patients/Patient Relatives About Anaesthesiologists and Anaesthesia Practices

	Total participant n = 400	Female n = 213 (%)	Male n = 187 (%)	*P* value
Who do you think performs the anaesthesia in surgery?				
Anaesthesiologist	306 (76.5)	162 (76.1)	144 (77)	0.74
Surgeon	13 (3.2)	6 (2.8)	7 (3.8)	
Anaesthesia technician	24 (6.0)	12 (5.6)	12 (6.4)	
Surgical nurse	7 (1.8)	3 (1.4)	4 (2.2)	
I do not know	50 (12.5)	30 (14.1)	20 (10.6)	
Who is the Anaesthesiologist?				
Medical physician	3 (0.8)	-	3 (1.6)	0.23
An authorised person who has not graduated from medical school but has had university and anaesthesia education	23 (5.8)	12 (5.6)	11 (5.9)	
Specialist physician who has graduated from medical school and had anaesthesia education	276 (69.0)	144 (67.6)	132 (70.6)	
I do not know	98 (24.5)	57 (26.8)	41 (21.9)	
Which is/are the duty/duties of an anaesthesiologist during surgery?				
They monitor the patient's sleep and wakefulness, that is, the state of consciousness	309 (77.3)	169 (79.3)	140 (74.9)	0.28
They monitor the blood pressure, pulse, respiration, and other vital functions of the patient	193 (48.3)	102 (47.9)	91 (48.7)	0.87
He/she ensures the patient does not have pain	211 (52.8)	110 (51.6)	101 (54.0)	0.63
They determine the necessary serum, blood and blood organs for the patient and ensure the required quantities of them to be supplied to the patient	135 (33.8)	70 (32.9)	65 (34.8)	0.68
What is/are the duty/duties of an anaesthesiologist out of the operating room?				
They work in intensive care units called reanimation	146 (36.5)	77 (36.2)	69 (36.9)	0.91
They examine the patients who will be given anaesthesia before the surgery in the anaesthesia outpatient clinic	246 (61.7)	125 (59.0)	121 (64.7)	0.23
They take part in various pain, especially cancer pain treatments	118 (29.5)	59 (27.7)	59 (31.6)	0.39
Anaesthetists anaesthetize patients in endoscopy units, nephrolithotomy, cardiology, and angiography laboratories, and radiology monitoring centers	150 (37.5)	72 (33.8)	78 (41.7)	0.12
In which method is anaesthesia applied to patients?				
Giving drugs intravenously	302 (75.5)	160 (75.1)	142 (75.9)	0.84
By making patients sniff gas*	200 (50.1)	95 (44.8)	105 (56.1)	0.02*
By anaesthetizing only, the area to be operated on*	228 (57.0)	110 (51.6)	118 (63.1)	0.02*
In which method is anaesthesia applied to patients?				
General anaesthesia	340 (85.0)	183 (85.9)	157 (84.0)	0.58
Local anaesthesia	255 (63.8)	133 (62.4)	122(65.2)	0.56
Regional anaesthesia (spinal, epidural, nerve blocks)*	244 (61.0)	144 (67.6)	100 (53.5)	0.004*

Categorical variables are shown as "number (%)". *P < 0.05, indicates statistical significance.

Compared with the women, the ratio of getting information about anaesthesia from "internet-press" (22.6% vs. 34.2%; *P*=0.010), the ratio of getting information from "surgeon" (18.3% vs. 28.3%; *P*=0.017) and the ratio of obtaining information from "friends-neighbours" (20.7% vs. 29.9%; *P*=0.032) were found to be significantly higher for the male participants. For the answers of the participants to the question, "By whom would you like to be informed before surgery about anaesthesia?", no significant difference was found in terms of sex (Table 3).

In comparison with other groups of participant patients/patient relatives with different education levels, the group of participants with college/university degrees had higher levels of knowledge about anaesthesia practices, anaesthetists' duties in the perioperative process, and their areas of work outside the OR, and this difference was statistically significant ($P < 0.001$). It was ascertained that, as the education level increased, the percentage of participants who acquired knowledge about anaesthesia from the internet/media ($P < 0.001$) and spouse/friends/neighbours (*P*=0.003) also increased.

It was found that, as per the education level, the participants with college/university degrees had a higher percentage of fear of anaesthesia than other groups of participants, and this difference was statistically significant (*P*=0.048). On the other hand, as per the education level, there was no statistically significant difference between the participants regarding the reasons for fearing anaesthesia ($P > 0.05$).

Based on previous surgeries under anaesthesia, there was no statistically significant difference in the participants' levels of knowledge about anaesthesia practices, anaesthetists' duties in the perioperative process, and their areas of work outside the OR ($P > 0.05$). In addition, the participants who had previously been under anaesthesia were also compared in terms of the scale of the surgical procedure. However, there was no statistically significant difference in their knowledge about anaesthesia, anaesthetists, and anxiety about anaesthesia ($P > 0.05$).

The ratio of patients/patient relatives who stated that they were afraid of anaesthesia was 53.3%, and a higher rate was observed in women than in men (58.7% vs. 47.1%; *P*=0.020). One-fifth (21.3%) of the participants were afraid of waking up during surgery, 22.3% were of feeling pain during surgery, 17.5% were afraid of nausea-vomiting, 14.5% were afraid of losing consciousness and saying something they did not want to, 8% were afraid of having a sore throat, 34.5% were scared about not being able to wake up from anaesthesia, and 13.5% were afraid of death. Nausea-vomiting (22.1% vs. 12.3%; *P*=0.010) and fear of not waking up from anaesthesia (42.3% vs. 25.7%; $P < 0.001$) were found to be higher in women compared with men (Table 4).

For the question, "What do you think about post-surgery pain?", 35.5% of the patients/patient relatives answered "It is a normal situation, I can tolerate it", 8.5% said "I think it is a sign of recovery", 28% responded "I think it will be an unbearable situation, I would definitely like my pain to stop", and 28% as "The important thing is the treatment of my primary disease, I don't care if I have pain or not." The ratio of participants who answered, "It is a normal situation, I can tolerate it" was higher in men, and the rate of those who answered "I think it will be an unbearable situation, I would definitely like my pain to stop" was higher in women. In addition, the ratio of those who wanted postoperative pain to stop was found to be significantly higher for patients who had undergone surgery previously (Figure 1).

Table 3. Methods used by Patients/Patient Relatives for Obtaining Information About Anaesthesia

	All participants n = 400 (%)	Female n = 213 (%)	Male n = 187 (%)	*P* value
Where did you get your information about anaesthesia?				
Internet-press*	112 (28.1)	48 (22.6)	64 (34.2)	0.010*
Anaesthesiologist	203 (50.8)	100 (46.9)	103 (55.1)	0.105
Surgeon*	92 (23.0)	39 (18.3)	53 (28.3)	0.017*
Friends-neighbours*	100 (25.0)	44 (20.7)	56 (29.9)	0.032*
By whom would you like to be informed about anaesthesia before surgery?				
Surgeon	79 (19.8)	42 (19.7)	37 (19.8)	0.35
Anaesthesiologist	312 (78.0)	168 (78.9)	144 (77.0)	
Anaesthesia technician	6 (1.5)	1 (0.5)	5 (2.7)	
Surgical nurse	3 (0.8)	2 (0.9)	1 (0.5)	

Categorical variables are shown as "number (%)". *$P < 0.05$, indicates statistical significance.

Table 4. Participant Patients'/Patient Relatives' Fears About Anaesthesia				
	All participants n = 400 (%)	**Female participants n = 213 (%)**	**Male participants n = 187 (%)**	***P* value**
Are you afraid of anaesthesia?*				
No	187 (46.8)	88 (41.3)	99 (52.9)	0.020*
Yes	213 (53.3)	125 (58.7)	88 (47.1)	
I will wake up during the operation	85 (21.3)	47 (22.1)	38 (20.3)	0.670
I will feel pain during the operation	89 (22.3)	49 (23.0)	40 (21.4)	0.699
I will feel nausea and vomit*	70 (17.5)	47 (22.1)	23 (12.3)	0.010*
I will make undesired comments due to losing consciousness	58 (14.5)	35 (16.4)	23 (12.3)	0.242
I will have sore throat	32 (8.0)	22 (10.3)	10 (5.3)	0.095
I will not be able to wake up even if the anaesthetic is stopped*	138 (34.5)	90 (42.3)	48 (25.7)	<0.001*
I will die	54 (13.5)	34 (16.0)	20 (10.7)	0.124
Categorical variables are expressed as "number (%)". *$P < 0.05$, denotes statistical significance.				

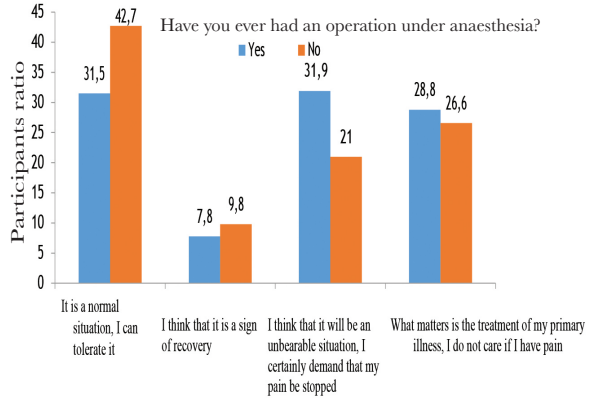

Figure 1. Percentage of the participants' views about postoperative pain based on having undergone surgery previously

Discussion

Along with the development of technology, anaesthesia practice has made considerable progress in recent years.[1] Despite these developments, society has limited knowledge about anaesthesia practices, anaesthetists' duties, and responsibilities according to several studies performed worldwide.[1,5,12]

The results of studies conducted to determine whether anaesthetists were specialists varied across countries. For instance, 51.75% of patients in Brazil,[13] 55.3% of the patients in Saudi Arabia,[5] 56% of patients in Pakistan,[12] 59% of patients in Latin America,[4] 74.8% of patients in South Korea,[14] 86% of patients in the state Minnesota in the United States of America (USA),[15] 92.3% of patients in Israel[7], and 99% of patients in Switzerland[16] knew that the anaesthetist was a specialist physician. According to the results of these studies, it can be asserted that, in line with the development level of countries, there is an increase in the percentage of knowledge of the anaesthetist. In the present study, 69% of the participants stated that the anaesthetist was a specialist physician with education in anaesthesia. In comparison with the results of studies performed across the world, it can be said that this percentage is about average. Nevertheless, the anaesthetist, in whom patients entrust their lives, was still not known by one-third of the participants of our study. The reasons for the inadequacy of knowledge about anaesthetists may be that the patients present to a surgeon first, they are forwarded by the surgeon to the anaesthetist, and their meetings with the anaesthetist were short relative to their encounters with other specialist physicians.

Patients experience intense anxiety due to anaesthesia and subsequent surgery. In addition, they do not know exactly the division of labor in the OR and who is responsible for each practice. A study conducted by sharing the patient data of Australia, Germany, and the USA showed that patients were partially informed about the perioperative process.[6] In our study, about the question about the anaesthetist's duties in the perioperative process, 77.3% of the participants said, "Anaesthetist follows up the patient's sleep and wakefulness, that is, patient's state of consciousness," 48.3% of the participants responded, "Anaesthetist follows up the patient's blood pressure, pulse, respiration, and other vital signs," 52.8% of the participants stated, "Anaesthetist ensures that the patient feels no pain," and 33.8% of the participants reported, "Anaesthetists identify which serum, blood, and blood products are necessary for the patient and assures that serum and/or blood and/or blood products are given to the patient at the quantity that they deem adequate." As per these data, it was discerned that the participants of the current study had inadequate knowledge about the perioperative resuscitative process.

Outside the OR, the anaesthetist gradually becomes more involved with duties such as resuscitation, intensive care, acute and chronic pain management, and radiology examinations and interventions. In several countries, ICUs are managed by anaesthetists. Some 17% of patients in Minnesota in the USA,[15] 57% of patients in Finland,[17] 20.2% of patients in South Korea,[14] and 46% of the patients in Israel[7] knew that the anaesthetist worked in ICUs, and 20% of patients in Minnesota in the USA,[15] 22% of patients in Finland,[17] 28.7% of patients in South Korea,[14] and 33.8% of patients in Israel[7] knew that anaesthetists worked in pain centers. It was found that, of the participants in the current study, 36.5% knew that anaesthetists worked in ICUs, 61.7% knew that anaesthetists worked in preoperative assessment clinics, 29.5% knew that anaesthetists worked in pain centers, and 37.5% knew that anaesthetists worked in places such as endoscopy units, nephrolithotomy, cardiology, and angiography laboratories, and radiology monitoring centers. A comparison of the results of the current study and those of studies conducted in other countries, shows that the results of our study are around the average values and the knowledge about this topic in our society and across the world is inadequate. The reasons for the inadequacy of knowledge about this topic could be that anaesthetists have acquired a professional identity only recently, anaesthetist's duties have expanded at an ever-increasing rate in recent years, and anaesthetists work as consultant physicians.

Being informed is accepted as an important patient right today.[18] In addition to preoperative evaluation, informed consent forms are used in our hospital to inform patients about anaesthesia. In our study, when we questioned where the participants attained their knowledge about anaesthesia, the ratio of those who learned it from an "anaesthesiologist" was highest at 50.8%, followed by "internet-press" (28.1%). An increase was observed in the ratio of those who learned their knowledge from "internet-press" in proportion to the increase in education level. While giving information, in addition to preoperative evaluations, media-based brochures, booklets, videos, and audio recordings can be used, and it has been shown that the use of these materials increases the knowledge level of patients and reduces their level of anxiety.[19] We think that it may be beneficial to use various communication tools to raise awareness on this issue.

Education level is one of the parameters used frequently in research to compare people's levels of knowledge about anaesthetists' duties and anaesthesia practices. A study by Eyelade et al.[18] stated that patients with degrees from tertiary education institutions had higher levels of knowledge about anaesthesia and anaesthetists. Shevde and Panagopoulos[19] found that there was no relationship between education level and knowledge about anaesthesia. In the current study, it was ascertained that participants with college/university degrees had higher levels of knowledge about anaesthesia, anaesthetists, and anaesthetists' duties inside and outside the OR, and this difference was statistically significant. This situation can be connected to the fact that participants with relatively high education levels were more curious about anaesthesia and surgery, made more effort, and used tools such as the internet more frequently to reach the knowledge that they aspired to obtain.

In a study conducted in Israel by Calman et al.,[1] the patients were categorized as those who had anaesthesia before and those who would be anaesthetized for the first time. Subsequently, the patient's levels of knowledge about anaesthesia practices and the anaesthetist were evaluated, and it was found that past experiences did not affect the patient's knowledge levels. Baja et al.[20] identified that the level of knowledge about anaesthesia increased along with past experiences, and the patients who had anaesthesia before had higher levels of knowledge than those who were curious about anaesthesia. However, in the current study, it was found that experience did not affect the level of knowledge about anaesthesia. Our study also investigated whether the severity of the surgeries that participants had previously undergone affected patients' levels of knowledge about anaesthesia and anaesthesiologists. However, this difference was not statistically significant.

It is common for patients to be afraid of anaesthesia in the preoperative period, and this situation adversely affects their surgery and postoperative recovery.[11] While more than half (53.3%) of the participants in the current study reported that they had a fear of anaesthesia, it was discerned that a higher percentage of female participants had a fear of anaesthesia than the male participants. Several studies have identified that females had a higher rate of anxiety than males. This situation may stem from males' desire to look powerful in the context of the existing sociocultural structure. Shevde and Panagopoulos[19] proposed that different results could be obtained if the test was performed by a psychologist.

According to previous research, in general, patients experience varying degrees of anxiety about situations such as being unable to wake up even if the anaesthetic is stopped, death, brain injury, paralysis, anaesthesia awareness, feeling pain during surgery, making meaningless comments while anaesthetized, feeling nauseous, vomiting, inadequate knowledge and experience of the anaesthetist, and the absence of an anaesthetist in the OR. According to the study by Nagrampa et al.,[21] patients mostly feared pain, followed by the fear of dying and having a brain injury. According to the studies by Ribeiro and Mourão[13] and Gottschalk et al.,[6] the patients' greatest fears were being unable to wake up after the surgery and having a postoperative infection. According to the study by Shevde and Panagopoulos[19], patients' fear was the anaesthetist's professional inadequacy. Matthey et al.[22] found that patients in their study feared

awareness during surgery. In our study, the patients' greatest fear was that they would be unable to wake up even if the anaesthetic was stopped.

According to whether the participants had undergone surgery with anaesthesia before and the severity of the surgery, no significant difference was observed among them between the fear rates of those who feared anaesthesia and the reasons for their fear. When the fears of our participants about anaesthesia were examined according to their education level, the rate of those who were afraid of anaesthesia was found to be higher in the college/university education group compared with the other education groups. However, there was no difference according to education level in terms of fear reasons. Observing a higher level of anxiety in patients with a high educational level can be attributed to having more information about complications.

In light of the responses to the questions about postoperative pain, it was considered that the female participants were more anxious about postoperative pain than the male participants. Patients who had undergone surgery before and had anaesthesia experience, want their pain to stop.

Study Limitations

The limitations of our study are the inability to generalize about the level of social knowledge because it is a cross-sectional and single-center study, and the inability to include the thoughts and comments of the patients that would contribute to the study, beyond the fixed questions and answers, because it is a questionnaire study.

Conclusion

In this survey, we evaluated the level of knowledge and concerns about anaesthesia applications and anaesthesiologists among our research participants. We found that the level of knowledge on this subject was insufficient and this lack of knowledge increased the level of anxiety in the preoperative period. We think that more objective results can be obtained on the level of knowledge and concern of our society by conducting national-based multi-centered studies. In light of this information, we concluded that, in addition to evaluating the patients in terms of the surgery, giving detailed information about the conditions and practices that would be experienced during the procedure and answering questions of the patients during preoperative visits would significantly reduce their anxiety levels. We determined that increasing the use of methods such as media-based brochures, booklets, videos, audio tapes, and preoperative and postoperative visits to inform patients may have a role in increasing patients' knowledge levels, reducing their anxiety levels, and increasing patient satisfaction.

Ethics Committee Approval: Ethical approval for this study (approval no: GO 17/113-27) was provided by the Non-Invasive Clinical Research Local Ethics Committee of Hacettepe University, Ankara, Turkey on February 28th, 2017.

Informed Consent: After the patients and/or their relatives consented to participate in the study upon being informed about the survey by the anaesthetist, they were asked to complete the survey form. The survey was administered verbally to participants and/or patient relatives who were illiterate and their verbal responses were recorded.

Peer-review: Externally peer-reviewed.

Author Contributions: Surgical and Medical Practices - M.Y.S., Ş.U.; Concept - M.Y.S., Ş.U.; Design - M.Y.S., Ş.U.; Data Collection or Processing - M.Y.S., M.İ., M.T., Ş.U.; Analysis or Interpretation - M.Y.S., M.İ., M.T., Ş.U.; Literature Search - M.Y.S., M.İ., M.T., Ş.U.; Writing - M.Y.S., M.İ., M.T., Ş.U.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Calman LM, Mihalache A, Evron S, et al. Current understanding of the patient's attitude toward the anesthetist's role and practice in Israel: effect of the patient's experience. *J Clin Anesth*. 2003;15(6):451-454. [CrossRef]
2. Klafta JM, Roizen MF. Current understanding of patients' attitudes toward and preparation for anesthesia: a review. *Anesth Analg*. 1996;83(6):1314-1321. [CrossRef]
3. Irwin MG, Fung SK, Tivey S. Patients' knowledge of and attitudes towards anaesthesia and anaesthetists in Hong Kong. *Hong Kong Med J*. 1998;4(1):16-22. [CrossRef]
4. Hariharan S, Merritt-Charles L, Chen D. Patient perception of the role of anesthesiologists: a perspective from the Caribbean. *J Clin Anesth*. 2006;18(7):504-509. [CrossRef]
5. Baaj J, Takrouri MS, Hussein BM, Al Ayyaf H. Saudi patients' knowledge and attitude toward anesthesia and anesthesiologists--A prospective cross-sectional interview questionnaire. *Middle East J Anaesthesiol*. 2006;18(4):679-691. [CrossRef]
6. Gottschalk A, Seelen S, Tivey S, Gottschalk A, Rich G. What do patients know about anesthesiologists? Results of a comparative survey in an U.S., Australian, and German university hospital. *J Clin Anesth*. 2013;25(2):85-91. [CrossRef]
7. Cohen B, Ogorek D, Oifa S, Cattan A, Matot I. Smart marketing may improve public understanding of the anesthesia profession. *Isr J Health Policy Res*. 2015;4(1):1-7. [CrossRef]
8. Onutu AH, Rus C, Acalovschi I. The public perception of the anaesthesiologist in Romania: a survey. *Rom J Anaesth Intensive Care*. 2017;24(1):21. [CrossRef]
9. Almutairi NG, Alorainy MH, Aldayel AM, et al. Public knowledge and perception of anesthesia, anesthesiologists'

expertise, and their role among Saudi citizens residing in Saudi Arabia. *Cureus.* 2023;15(8). [CrossRef]

10. Arefayne NR, Getahun AB, Melkie TB, et al. Patients' knowledge and perception of anesthesia and the anesthetists: Cross-sectional study. *Ann Med Surg (Lond).* 2022;78:103740. [CrossRef]
11. Boeke S, Jelicic M, Bonke B. Pre-operative anxiety variables as possible predictors of post-operative stay in hospital. *Br J Clin Psychol.* 1992;31(3):366-368. [CrossRef]
12. Fauzia A K, Shakir H, Asif Z. Patients view of the anaesthetist in a developing country. *J Pak Med Assoc.* 1999;49(1):4-7. [CrossRef]
13. Ribeiro CS, Mourão JIdB. [Anesthesiologist: the patient's perception]. *Rev Bras Anestesiol.* 2015;65(6):497-503. [CrossRef]
14. Lee JJ, Lee NH, Park CM, et al. Public awareness about the specialty of anesthesiology and the role of anesthesiologists: a national survey. *Korean J Anesthesiol.* 2014;66(1):12-17. [CrossRef]
15. Garcia-Marcinkiewicz AG, Long TR, Danielson DR, et al. Health literacy and anesthesia: patients' knowledge of anesthesiologist roles and information desired in the preoperative visit. *J Clin Anesth.* 2014;26(5):375-382. [CrossRef]
16. Kindler CH, Harms C, Alber C. [The patients' perception of the anaesthetist in a Swiss university hospital]. *Anaesthesist.* 2002;51(11):890-896. [CrossRef]
17. Tohmo H, Pälve H, Illman H. The work, duties and prestige of Finnish anesthesiologists: patients' view. *Acta Anaesthesiol Scand.* 2003;47(6):664-666. [CrossRef]
18. Eyelade OR, Akinyemi J, Adewole I. Patients' perception and knowledge of anaesthesia and anaesthetists-a questionnaire survey. *SAJAA.* 2010;16(4):28-31. [CrossRef]
19. Shevde K, Panagopoulos G. A survey of 800 patients' knowledge, attitudes, and concerns regarding anesthesia. *Anesth Analg.* 1991;73(2):190-198. [CrossRef]
20. Baja J, Welker AS, Beck G, et al. [Professional image of anesthetists in the general public. Influence of provision of information and previous experience with the discipline]. *Anaesthesist.* 2014;63(2):114-121. [CrossRef]
21. Nagrampa D, Bazargan-Hejazi S, Neelakanta G, et al. A survey of anesthesiologists' role, trust in anesthesiologists, and knowledge and fears about anesthesia among predominantly Hispanic patients from an inner-city county preoperative anesthesia clinic. *J Clin Anesth.* 2015;27(2):97-104. [CrossRef]
22. Matthey P, Finucane BT, Finegan BA. The attitude of the general public towards preoperative assessment and risks associated with general anesthesia. *Can J Anaesth.* 2001;48(4):333-339. [CrossRef]

DOI: 10.4274/TJAR.2023.231464

Original Article
Preoperative Care

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):485-490

Effect of the Gupta Score on Pre-operative Cardiology Consultation Requests in Noncardiac Nonvascular Surgery

Funda Atar, Fatma Özkan Sipahioğlu, Gülsen Keskin, Aslı Dönmez

University of Health Sciences Turkey, Etlik City Hospital, Clinic of Anaesthesiology and Reanimation, Ankara, Turkey

Cite this article as: Atar F, Özkan Sipahioğlu F, Keskin G, Dönmez A. Effect of the Gupta Score on Pre-operative Cardiology Consultation Requests in Noncardiac Nonvascular Surgery. *Turk J Anaesthesiol Reanim.* 2023;51(6):485-490.

Abstract

Objective: Cardiologists are the most frequently consulted specialists during pre-operative evaluations. However, unnecessary cardiology consultations (CC) can increase cardiologists' workload without impacting anaesthesia practice, resulting in delayed surgeries and additional financial burdens. We hypothesize that using Gupta during the preoperative period can reduce these adverse effects.

Methods: This prospective study included patients scheduled for elective noncardiac, nonvascular surgeries who underwent pre-operative assessment. Patients who had no specific risk index used for preoperative cardiac risk evaluation were classified as Group I, and those evaluated using the Gupta scale were classified as Group II. The study compared preoperative CC, diagnostic tests, surgical delays, major adverse cardiac event (MACE), length of hospital stay and intensive care unit (ICU) stay, mortality, and costs.

Results: A total of 898 patients were included in the study, with 487 in Group I and 411 in Group II. The Gupta group reduced the demand for preoperative CC (P<0.001) and preoperative non-invasive diagnostic testing (n = 107, 21.9% vs. n = 36, 8.75%). The time from the anaesthesiology outpatient clinic to surgery was 15 days in Group I and 14 days in Group II (P=0.132). The length of ICU stay was higher in Group I (P=0.019). MACE was 15 patients (3.08%) in Group I and 9 patients (2.19%) in Group II (P=0.076). The cost of patients in Group I was higher than that in Group II (P=0.019).

Conclusion: Using Gupta in preoperative evaluation may reduce unnecessary preoperative resource usage, surgical delays, ICU hospitalization rates, additional costs, and mortality.

Keywords: Cardiac risk stratification, cardiology consultation, pre-operative care

Main Points

- It was determined that using the Gupta score before elective noncardiac, nonvascular surgery decreased preoperative cardiology consultation and non-invasive diagnostic tests.
- It was observed that the time to surgery and the length of stay in the intensive care unit decreased in patients who were evaluated by using the Gupta score.
- Changing the perspective on preoperative cardiology consultation and requesting more rational consultations may be cost-effective.

Introduction

As 42% of overall complications in noncardiac, nonvascular surgery (NCNVS) stem from cardiac-related issues, cardiologists are the most commonly consulted specialists during pre-operative evaluations.[1] However, unnecessary cardiology consultations (CCs) can increase cardiologists' workload without impacting anaesthesia practice, resulting in delayed surgeries, wasted time, and additional financial burdens.[2] Recently, a predictive model called the Gupta score was developed, which uses the American College of Surgeons National Surgical Quality Improvement

Corresponding author: Funda Atar, e-mail: fundaatar81@gmail.com

Received: November 06, 2023 Accepted: November 15, 2023

Program (NSQIP) database to estimate the risk of perioperative major adverse cardiac events (MACEs), such as myocardial infarction (MI) or cardiac arrest.[3] The Gupta score is an interactive risk calculation program.[3] The risk score comprises 5 items: type of surgery, the participant's functional status, abnormal creatinine levels (>130 mmol L or >1.5 mg dL^{-1}), American Society of Anesthesiologists (ASA) classification, and age.[4] Unlike previously used indexes, the Gupta score provides individualized probability estimation for MACE rather than a scoring system. Based on the Gupta score, patients with an estimated perioperative MACE risk of <1% can proceed with surgery without requiring further cardiac workup, whereas those with a risk of MACE exceeding 1% are considered high-risk and may necessitate CC for preoperative testing and treatment.

Although the surgical risk models suggested by the current guidelines recommend avoiding unnecessary preoperative consultation and workup, the effect of these risk models on the CC rate and optimal preoperative evaluation is not obvious in daily practice. This study aims to address this gap by evaluating the effect of the Gupta score on the CC rate in patients scheduled for elective, intermediate/high-risk NCNVS. Additionally, the study seeks to observe the broader impact of implementing a strategy based on the Gupta score on perioperative clinical outcomes, resource utilization [including transthoracic echocardiography (ECO), Holter monitorization, scintigraphy, coronary angiography, etc.], and additional costs.

Methods

The study was approved by the Clinical Research Ethics Committee of University of Health Sciences Turkey, Dışkapı Yıldırım Beyazıt Training and Research Hospital (approval no: 128/21, date: 10.01.2022), and this trial was registered at ClinicalTrials.gov (NCT05532917). Written informed consent was obtained from all patients participating in the trial. Informed consent was obtained from each patient, and the study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee.

From February 01, 2022 to March 31, 2022, patients aged ≥18 years who were scheduled for elective intermediate/high-risk NCNVS underwent routine preoperative assessment in an outpatient clinic. The type of surgery was categorized on the basis of surgical risk, following the American College of Cardiology/American Heart Association classification.[5] Each patient received a comprehensive evaluation, including medical history, physical examination, electrocardiogram, complete blood cell count, chemistry, chest roentgenogram, and any additional assessments deemed necessary by the anaesthesiologist.

The ASA classification was used as an index to determine a patient's general status.[2] The New York Heart Association Functional Classification (NYHA) and Revised Cardiac Risk Index (RCRI) were calculated for each patient.[6] The study population was divided into 2 groups based on their preoperative cardiac risk assessment: Group I (no specific risk index used for preoperative cardiac risk evaluation) and Group II (using the Gupta score for preoperative cardiac risk assessment). Two different expert anaesthetists performed the pre-operative assessment.

The main reason for referral for CC was classified into 8 categories: a. hypertension (HT), b. general evaluation, c. coronary artery disease (CAD)- anticoagulation management, d. elderly patient, and e. electrocardiography (ECG) changes, f. valve abnormality, and h. other. Demographic and personal characteristics of patients [ASA, age, gender, body mass index, time to CC and surgery, length of stay hospital and intensive care unit (ICU), the surgery type and risk, diagnostic tests requested by the cardiologist (ECG, ECO, Holter monitoring, cardiovascular stress test, scintigraphy, coronary angiogram, percutaneous coronary intervention (PCI)], NYHA, RCRI, 30-day mortality, and MACE were recorded. MACE was defined according to the NSQIP: Documentation of ECG changes indicative of acute MI (one or more of the following: ST-elevation >1 mm in 2 or more contiguous leads, new left bundle branch block, new q-wave in 2 or more contiguous leads); new elevation in troponin greater than 3 times the upper level of the reference range in the setting of suspected myocardial ischemia.[7] The cost was determined by scanning accessible data in hospital billing statements and calculating charges for each test ordered and the hospitalization.

The data were statistically analyzed using IBM SPSS Statistics for Windows, Version 20.0. package program. Data are summarized as mean ± standard deviation and median (25-75%) for continuous variables, frequencies, and percentiles for categorical variables. The Mann-Whitney U test and Student's t-test were used for independent group (Group I, n = 487 and Group II, n = 411) comparisons, depending on the distributional properties of the data based on groups (according to results of Shapiro Wilk test). The chi-square test was used for proportions, and its counterpart Fisher's exact test was used when the data were sparse. For all statistical analyses, any *P* value less than 0.05 was considered statistically significant.

Results

A total of 898 patients were included in the study, with 487 in Group I and 411 in Group II. During the pre-operative period, 22 (4.52%) patients in Group I and 3 (0.73%) patients in Group II refused surgery (*P*=0.001) (Figure 1). Preoperative CC was performed by 185 (37.9%) patients in

Group I and 63 (15.3%) patients in Group II ($P < 0.001$). Demographic data, ASA, NYHA, comorbidity, and RCRI were similar in both groups. The smoking rate was higher in Group II (Table 1). In Group I, the most common reasons for consultation were HT (n = 44, 23.78%) and general evaluation (n = 37, 20%). The mean age of Group I was 55.57±16.06 years, whereas for patients who requested CC due to the general evaluation, the mean age was 62.05±9.03 years. Other preoperative reasons leading to consultation with a cardiologist are listed in Table 2.

Preoperative cardiac testing was more common in Group I patients than in Group II patients (n = 107, 21.9% vs n = 36, 8.75%). ECO was the most frequently performed test in both groups (n = 87, 60% in Group I; n = 33, 23.07% in Group II; $P < 0.01$, respectively), followed by Holter monitoring in 8 cases (5.6%). In Group I, other performed tests included exercise stress ECG (n = 5, 4.6%), coronary angiogram (n = 4, 3.7%), myocardial scintigraphy (n = 3, 2.8%), and PCI (n = 2, 1.8%). None of the patients in Group II requested cardiovascular stress testing, angiography, scintigraphy, or PCI (Figure 2).

Table 1. Demographic and Clinical Characteristics, NYHA Functional Class and Revised Cardiac Risk Index of Patients

	Group I (n = 487)	Group II (n = 411)	*P* value
Age (years)	55.57±16.06	53.78±16.99	0.134
BMI (kg m^{-2})	1.67±0.085	1.67±0.079	0.325
Gender			
Male n (%)	249 (51.13)	202 (49.15)	0.554
Female n (%)	238 (48.87)	209 (50.85)	
ASA status, n (%)			
ASA I	130 (26.69)	102 (24.82)	
ASA II	289 (59.34)	250 (60.83)	
ASA III	66 (13.55)	57 (13.87)	0.92
ASA IV	2 (0.41)	2 (0.49)	
Comorbidity, n (%)			
Diabetes mellitus	122 (25.05)	86 (20.92)	0.144
Systemic hypertension	183 (37.58)	158 (38.44)	0.790
Hyperlipidemia	14 (2.87)	31 (7.54)	0.001
Heart failure	4 (0.82)	10 (2.43)	0.052
Coronary artery disease	59 (12.11)	57 (13.87)	0.435
Peripheral artery disease	7 (1.44)	4 (0.97)	0.529
Atrial fibrillation	9 (1.85)	12 (2.92)	0.290
Chronic pulmonary disease	49 (10.06)	34 (8.27)	0.356
Serebrovascular disease	7 (1.44)	9 (2.19)	0.396
History of malignancy	55 (11.29)	32 (7.79)	0.077
Chronic renal failure	10 (2.05)	13 (3.16)	0.294
Alzheimer's disease	1 (0.21)	0	1
Thyroid dysfunction	42 (8.62)	38 (9.25)	0.745
Current smoking, n (%)	80 (16.43)	168 (40.88)	<0.001
NYHA functional class, n (%)			
1	304 (62.42)	255 (62.04)	
2	143 (29.36)	105 (25.55)	
3	39 (8.01)	48 (11.68)	0.129
4	1 (0.21)	3 (0.73)	
Revised cardiac risk index, n (%)			
Low	415 (85.22)	348 (84.67)	
Medium	51 (10.47)	41 (9.98)	0.754
High	21 (4.31)	22 (5.35)	

Values are given as mean ± SD or number (percentage) unless otherwise indicated.
NYHA, New York Heart Association; BMI, body mass index; ASA, American Society of Anesthesiologists.

Table 2. Main Reason to Refer a Patient to a Cardiologist in Group I	
	Group I (n = 487)
Systemic hypertension	44 (23.78)
General evaluation	37 (20)
Coronary artery disease-Anticoagulation management	31 (16.76)
Age	25 (13.51)
Abnormal electrocardiogram	11 (5.9)
Evaluation of valve abnormality	1 (0.54)
Other	36 (19.46)
Total	185 (37.9)
Values are given as number (percentage) unless otherwise indicated.	

Table 3. Adverse Perioperatif Cardiovascular and Noncardiovascular Outcomes			
	Group I (n = 487)	**Group II (n = 411)**	***P* value**
Systemic hypertension	3 (20)	1 (11.11)	0.076
MACE	5 (33.33)	4 (44.44)	
Pulmonary embolism	3 (20)	0	
Severe arrhythmia	1 (6.67)	2 (22.22)	
Chest pain	1 (6.67)	1 (11.1)	
Hypoxemia	2 (13.3)	0	
Pericardial effusion	0	1 (11.1)	
Average length of stay (days) (mean ± SD)	2.26±3.26	1.9±2.28	0.385
Average length of ICU stay (days) (mean ± SD)	3.88±4.55	2.47±2.44	*0.019
In-hospital mortality	4 (0.82)	1 (0.24)	0.383
30 day mortality	11 (2.26)	4 (0.97)	*0.191
Cost (TL) median (min.-max.)	63.0 (43.0-566651,20)	53.13 (22.52-56570,0)	*0.019
Values are given as mean ± SD, number (percentage) or median (min.-max.) unless otherwise indicated. MACE, major adverse cardiac event; ICU, intensive care unit; TL, Turkish Lira; SD, standard deviation; min.-max., minimum-maximum.			

In both groups, patients who requested CC were frequently examined by a cardiologist in the outpatient anaesthesiology clinic on the same day [interquartile range (IQR) 0-1]. The time interval from the anaesthesiology outpatient clinic to surgery was 15 days (IQR 7-31) in Group I and 14 days (IQR 7-28) in Group II (*P*=0.132). A total of 15 patients (3.08%) in Group I and 9 patients (2.19%) in Group II had perioperative cardiovascular complications (p= 0.076). The distribution of cardiovascular complications was comparable between the two groups (*P*=0.14). The most common cardiac complication was acute coronary syndrome (Table 3).

The hospital length of stay for the patients was similar between the two groups (*P*=0.385), whereas the ICU length of stay was higher in Group I (3.88±4.55 vs. 2.47±2.44, *P*=0.019). The 30-day mortality rate was 2.26% (n = 11) in Group I and 0.97% (n = 4) in Group II (*P*=0.191). The cost of patients in Group I was higher than that in Group II 63.0 (43.0-566651.20) TL vs. 53.13 (22.52-56570.0) TL, *P*=0.019) (Table 3).

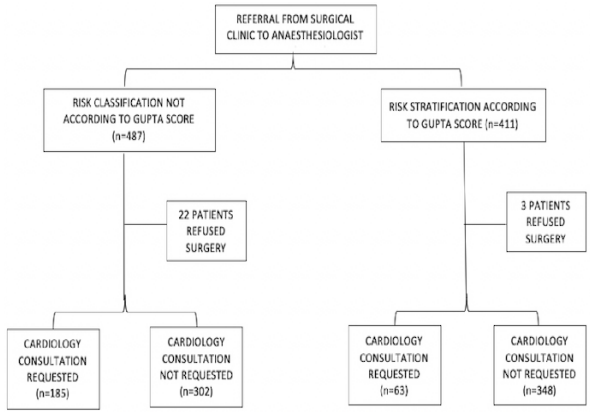

Figure 1. Flowchart of the study

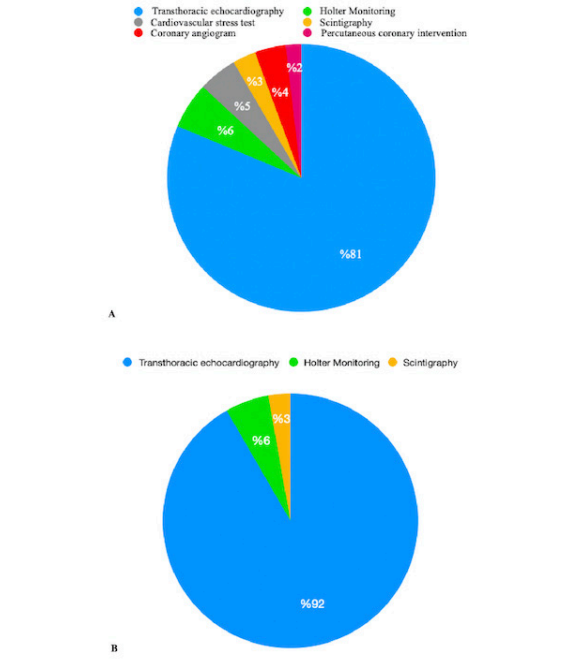

Figure 2. Tests ordered in patients with cardiology consultation. A: in Group I, B: in Group II

Discussion

The present study shows that using the Gupta score before elective NCNVS reduces preoperative CC. Furthermore, there was a decrease in the number of preoperative non-invasive diagnostic tests requested when the Gupta score was used. In patients who used the Gupta score, the time to surgery decreased by approximately 1 day, and the length of stay in the intensive care unit decreased by an average of 1.41 days. Although there was no statistical difference, adhering to the Gupta score resulted in fewer occurrences of MACE. Moreover, the use of the Gupta score for the desired CC was found to be more cost-effective.

Preoperative cardiac evaluation based on guidelines has significantly reduced unnecessary consultations.[8,9] Kleinman et al.[10] argued that CC requests were necessary and could detect newly diagnosed HT and angina in 15% of the study groups. However, the detection of any clinical problem by cardiologists contributed little to clinical decision-making and did not reduce perioperative cardiovascular complications.[11] The fear of missing important issues or malpractise lawsuits might have led clinicians to lower the threshold for requesting preoperative consultations. Nevertheless, most consultations provide no suggestions beyond "cleared for surgery", "proceed with the case", or "continue present medications".[11] Demand for preoperative consultations based on cardiac risk indices may reduce unnecessary investigations, improve cost-effectiveness, and avoid delays. We observed that adhering to the Gupta score for cardiac evaluation before NCNVS reduced the incidence of preoperative CC by more than half. Consequently, following and applying current risk models can help reduce unnecessary consultations.

In our study, among patients who did not undergo a specific protocol for preoperative cardiovascular evaluation, HT and general evaluation were the most common causes of CC. It has been observed that controlled HT may cause unnecessary CC because it does not affect cardiovascular morbidity or mortality.[12] Therefore, HT alone may not be a sufficient reason for consultation. Another probable issue is that the physician initiating the consultation might not have clearly communicated to the cardiologist why the consultation is being sought. We found that the mean age of the patients who were requested to undergo CC due to the general evaluation in our study was 62 years, which may have contributed to this higher rate. However, this non-specific manner of referral often leads to a general diagnostic work-up and reduces the impact of CC on perioperative management.[11] Based on these results, we predict that stating the indications for the consultation request correctly and clearly can reduce the unnecessary burden and waste of resources in the cardiology department.

The Gupta score reduced the use of preoperative non-invasive diagnostic tests. Furthermore, when CC was requested based on the Gupta score, there was a reduced need for ECO, and no requests were made for cardiovascular stress tests, angiography, scintigraphy, or PCI. Additionally, the time from the anaesthesia outpatient clinic to the surgery was approximately 24 h less in patients using the Gupta score. We believe that more appropriate and less demanding preoperative cardiac tests may cause this situation. Similarly, excessive preoperative cardiac testing can cause surgery delays and increase mortality during the perioperative period.[11-13] We acknowledge that unnecessary CC requests and preoperative cardiac tests are not the only factors causing the delay; it may be multifactorial. However, it has been shown that minimizing surgical delay can reduce mortality.[14] Therefore, we believe that it is necessary to weigh the benefits of further cardiac evaluation for preoperative optimization versus the morbidity and mortality caused by the delay in surgery.

CAD can be considered one of the most critical comorbidities expected to increase the risk of perioperative MACE.[9] In our study population, both groups scheduled for intermediate/high-risk surgical procedures had multiple risk factors for CAD or a history of ischemic heart disease. Clinicians may have demonstrated an increased tendency for CC in this patient group because of the perceived risk of perioperative MI and other significant adverse cardiac events.[9] Nevertheless, although our study had no statistical difference, MACE was seen less frequently when adhering to the Gupta score. Routine cardiac examination for CAD assessment is not entirely safe and often does not contribute to preoperative clinical decision-making preoperatively.[15,16] Therefore, current guidelines do not recommend routine preoperative CC for patients with CAD or risk factors.[6] In conclusion, in patients with cardiac comorbidities, the desired CC based on current risk models appears to be more effective than an approach based on routine cardiac examination.

Our study demonstrated that the Gupta score for CC resulted in decreased resource usage (cardiac diagnostic test), leading to increased efficiency. This reduction in resource utilization alleviates the workload of healthcare staff and offers economic advantages. Approximately 20-34% of healthcare costs are spent on ineffective measures are indicated. Hence, identifying and mitigating these unnecessary expenses has become of paramount importance. Cost-effective healthcare delivery is especially crucial for developing countries. One of the major contributors to healthcare costs is the inappropriate use of advanced medical technology and services.[17] Non-specific consultations and workups may lead to false positive results, unnecessary, costly, and potentially harmful treatments, or further evaluation that may delay surgery.[18] If the findings of our study were generalized to other clinics nationwide, we believe it could substantially reduce unnecessary costs.

Conclusion

Several remarks must be considered when interpreting these results. Despite the completeness of the collected data and the high level of follow-up, the study could not be randomized. In addition, surgery delay is multifactorial, and other relevant factors were not included in our analysis.

In conclusion, the Gupta score enables patients to easily and accurately calculate their preoperative mortality risk at the bedside or in the clinic. Thus, unnecessary consultations, workups, surgery delays, and additional costs can be avoided.

Ethics Committee Approval: The study was approved by the Clinical Research Ethics Committee of University of Health Sciences Turkey, Dışkapı Yıldırım Beyazıt Training and Research Hospital (approval no: 128/21, date: 10.01.2022), and this trial was registered at ClinicalTrials.gov (NCT05532917).

Informed Consent: Written informed consent was obtained from all patients participating in the trial.

Peer-review: Internally peer-reviewed.

Author Contributions: Surgical and Medical Practices - F.A., F.Ö.S.; Concept - G.K., A.D.; Design - A.D.; Data Collection or Processing - F.A., F.Ö.S.; Analysis or Interpretation - F.A., G.K., A.D.; Literature Search - F.A., F.Ö.S.; Writing - F.A.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Groot MW, Spronk A, Hoeks SE, Stolker RJ, van Lier F. The preoperative cardiology consultation: indications and risk modification. *Neth Heart J*. 2017;25(11):629-633. [CrossRef]
2. Dogan V, Biteker M, Özlek E, et al. Impact of preoperative cardiology consultation prior to intermediate-risk surgical procedures. *Eur J Clin Invest*. 2018;48(9):e12794. [CrossRef]
3. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines. Developed in collaboration with the American College of Surgeons, American Society of Anesthesiologists, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Vascular Medicine Endorsed by the Society of Hospital Medicine. *J Nucl Cardiol*. 2015;22(1):162-215. [CrossRef]
4. Gupta PK, Gupta H, Sundaram A, et al. Development and validation of a risk calculator for prediction of cardiac risk after surgery. *Circulation*. 2011;124(4):381-387. [CrossRef]
5. Fleisher LA, Fleischmann KE, Auerbach AD, et al. 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery: a report of the American College of Cardiology/American Heart Association Task Force on practice guidelines. *J Am Coll Cardiol*. 2014;64(22):e77-137. [CrossRef]
6. Lee TH, Marcantonio ER, Mangione CM, et al. Derivation and prospective validation of a simple index for prediction of cardiac risk of major noncardiac surgery. *Circulation*. 1999;100(10):1043-1049. [CrossRef]
7. Bilimoria KY, Liu Y, Paruch JL, et al. Development and evaluation of the universal ACS NSQIP surgical risk calculator: a decision aid and informed consent tool for patients and surgeons. *J Am Coll Surg*. 2013;217(5):833-42.e1-3. [CrossRef]
8. Katz RI, Cimino L, Vitkun SA. Preoperative medical consultations: impact on perioperative management and surgical outcome. *Can J Anaesth*. 2005;52(7):697-702. [CrossRef]
9. Cinello M, Nucifora G, Bertolissi M, et al. American College of Cardiology/American Heart Association perioperative assessment guidelines for noncardiac surgery reduces cardiologic resource utilization preserving a favourable clinical outcome. *J Cardiovasc Med (Hagerstown)*. 2007;8(11):882-888. [CrossRef]
10. Kleinman B, Czinn E, Shah K, Sobotka PA, Rao TK. The value to the anesthesia-surgical care team of the preoperative cardiac consultation. *J Cardiothorac Anesth*. 1989;3(6):682-687. [CrossRef]
11. Aslanger E, Altun I, Guz G, et al. The preoperative cardiology consultation: goal settings and great expectations. *Acta Cardiol*. 2011;66(4):447-452. [CrossRef]
12. Thilen SR, Wijeysundera DN, Treggiari MM. Preoperative Consultations. *Anesthesiol Clin*. 2016;34(1):17-33. [CrossRef]
13. Smeets SJ, Poeze M, Verbruggen JP. Preoperative cardiac evaluation of geriatric patients with hip fracture. *Injury*. 2012;43(12):2146-2151. [CrossRef]
14. Stitgen A, Poludnianyk K, Dulaney-Cripe E, Markert R, Prayson M. Adherence to Preoperative Cardiac Clearance Guidelines in Hip Fracture Patients. *J Orthop Trauma*. 2015;29(11):500-503. [CrossRef]
15. Cinello M, Nucifora G, Bertolissi M, et al. American College of Cardiology/American Heart Association perioperative assessment guidelines for noncardiac surgery reduces cardiologic resource utilization preserving a favourable clinical outcome. *J Cardiovasc Med (Hagerstown)*. 2007;8(11):882-888. [CrossRef]
16. Glance LG, Faden E, Dutton RP, et al. Impact of the Choice of Risk Model for Identifying Low-risk Patients Using the 2014 American College of Cardiology/American Heart Association Perioperative Guidelines. *Anesthesiology*. 2018;129(5):889-900. [CrossRef]
17. Apfelbaum JL, Connis RT, Nickinovitch DG, et al. Practice advisory for preanesthesia evaluation: An updated report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation. *Anesthesiology*. 2012;116:522-538. [CrossRef]
18. Oliveira ACC, Schwingel PA, Santos LAD, Correia LCL. The inductor role of cardiac consultation in the pre-anesthetic evaluation of asymptomatic patients submitted to non-cardiac minor and intermediate-risk surgery: a cross-sectional study. *Braz J Anesthesiol*. 2021;71(5):530-537. [CrossRef]

DOI: 10.4274/TJAR.2023.231477

Original Article

Cardiovascular and Thoracic Anaesthesia

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):491-495

The Influence of Pre-operative Pain and Anxiety on Acute Postoperative Pain in Cardiac Surgery Patients Undergoing Enhanced Recovery after Surgery

Aslıhan Aykut[1], Nevriye Salman[1], Zeliha Aslı Demir[1], Atakan Furkan Eser[1], Ayşegül Özgök[1], Serdar Günaydın[2]

[1]University of Health Sciences Turkey, Ankara Bilkent City Hospital, Clinic of Anaesthesiology and Reanimation, Ankara, Turkey

[2]University of Health Sciences Turkey, Ankara Bilkent City Hospital, Clinic of Cardiovascular Surgery, Ankara, Turkey

Cite this article as: Aykut A, Salman N, Demir ZA, Eser AF, Özgök A, Günaydın S. The Influence of Pre-operative Pain and Anxiety on Acute Postoperative Pain in Cardiac Surgery Patients Undergoing Enhanced Recovery after Surgery. *Turk J Anaesthesiol Reanim.* 2023;51(6):491-495.

Abstract

Objective: Perioperative multimodal analgesia is an important step in enhanced recovery after surgery (ERAS) care. Many factors, such as preoperative chronic pain and anxiety, may provide information about the expected postoperative pain. In this study, we evaluated preoperative pain and anxiety and investigate their effects on acute postoperative pain in patients undergoing elective cardiac surgery.

Methods: After ethics committee approval, 67 consenting patients undergoing on-pump cardiac surgery under the ERAS program were included in our prospective observational study. Pre- and postoperative pain scores were obtained using a numeric rating scale (NRS) at rest and during movement. Preoperative anxiety was assessed on a 0-10 scale, and data were recorded. The relationships between pre-operative pain/anxiety and postoperative pain were evaluated using correlation analysis.

Results: In preoperative pain assessment, the percentage of patients with a pain score above 4 with NRS was 1.5%, regardless of whether they were at rest or mobilize. In postoperative pain assessment, there were 20.9% and 34.3% patients with NRS >4 at rest and mobilization, respectively. 7.5% of patients had preoperative anxiety of grade 5 or higher. While preoperative pain was not correlated with postoperative pain, preoperative anxiety had a moderate positive correlation with postoperative pain (r=0.382, *P*=0.003).

Conclusion: The prevalence of preoperative pain in patients who underwent cardiac surgery is quite low and is not associated with postoperative pain. There is also a significant relationship between the severity of preoperative anxiety and postoperative pain.

Keywords: Cardiovascular and thoracic anaesthesia, enhanced recovery after surgery, multimodal analgesia, pain, preoperative anxiety

Main Points

- Enhanced recovery after surgery (ERAS) recommends perioperative pain management with multimodal, non-opioid medications and detailed planning.
- Identification of preoperative pain predictors may enable patients at high risk of postoperative pain to receive personalized and successful treatment.
- The incidence of preoperative pain in cardiac surgery patients is low and not associated with postoperative pain. We believe that preoperative pain assessment does not contribute to pain management in cardiac surgery patients undergoing ERAS.
- We found that preoperative anxiety is associated with postoperative acute pain; therefore, we believe that interventions to prevent anxiety in the ERAS protocol will also contribute to postoperative pain management.

Corresponding author: Aslıhan Aykut, e-mail: asli_dncr@hotmail.com

Received: November 11, 2023 Accepted: November 21, 2023

Introduction

Postoperative pain is a cause of concern in patients undergoing heart surgery. Studies show that 47-75% of patients experience pain in the postoperative period, and it is often severe and undertreated. Patients recovering from cardiac surgery present a challenge when it concerns pain management because of the different characteristics of each patient and each procedure. Different methods of assessing postoperative pain in cardiac surgery patients have been validated.[1]

The enhanced recovery after surgery (ERAS) program uses multimodal and transdisciplinary approaches to reduce stress response and complications, eliminate postoperative pain, prevent the known side effects of opioids, and weaken the catabolic process. Providing perioperative multimodal analgesia constitutes an important step in these care pathways. Studies investigating the ERAS program, which is still an evolving intervention, have used paracetamol, gabapentin, non-steroidal anti-inflammatory drugs, and opioids in a multimodal analgesia regimen.[2] Many factors such as preoperative pain, preoperative opioid use, previous postoperative pain experience, inappropriate patient expectations, surgical outcome anxiety, psychological factors, and functional pain can provide information about the expected postoperative pain in the patient evaluated preoperatively.[3,4] By identifying these risks, postoperative pain management can be provided in a patient-specific manner. It has been stated that in noncardiac surgeries where ERAS is applied, patients may have some pain in the pre-operative period, and this should be evaluated in the pre-operative period.[5] However, no study has evaluated the presence and severity of preoperative pain in terms of cardiac surgery. The effect of preoperative education on pain relief has mostly been investigated.[6] It has been emphasized that preoperative anxiety levels are moderate and severe in patients undergoing cardiac surgery and that the presence of anxiety is associated with high postoperative pain scores.[4]

Because pain and anxiety are relatively subjective symptoms that show ethnic, identity, and national differences, we sought to determine the pre-operative pain and anxiety status in our own patient group, i.e., patients preparing for heart surgery, within the scope of the ERAS programs we currently implement at one of the largest cardiac surgery centers in our country. The aim of this study was to evaluate the presence of preoperative pain and anxiety in ERAS patients undergoing elective cardiac surgery and to investigate their effects on acute postoperative pain.

Methods

This prospective, observational study was performed in conformance with the principles of the Declaration of Helsinki and was validated by the Ankara City Hospital No. 1 Clinical Research Ethics Committee (approval no: E1-22-2613, date: 15.06.2022). After written informed consent was obtained, 67 consecutive adult patients scheduled for elective open cardiac surgery in an ERAS program in 2023 were observed throughout the perioperative period. Adult patients who had undergone open cardiac surgery with cardiopulmonary bypass (CPB) within the scope of the ERAS protocol were included in the study. Patients with local anaesthetic allergy, body mass index greater than 35 kg m^{-2}, emergency or re-do surgery, off-pump surgery, transplantation surgery, vascular surgery, age younger than 18 years, American Society of Anesthesiologists class IV (severe organ dysfunction), alcohol-drug use, and patients who died during or immediately after the operation were excluded from the study.

All patients received peroral pregabalin (150 mg) and antibiotic prophylaxis with cefazolin sodium (1000 mg) intravenously preoperatively. They were visited by a physiotherapist and started respiratory exercises 24 h before the operation. Patients had 6-8 h of fasting but drank 400 mL 12.5% maltodextrin 2 h before surgery. In the operating rooms, pulse oximetry, five-channel electrocardiography, and bispectral index monitoring (BIS™, Covidien, MN, ABD) were performed. 18 G and 16 G peripheral intravenous catheters and a radial arterial catheter were inserted under local anaesthesia.

Erector spinae plane (ESP) block was performed in the operating room during the pre-anaesthesia period with the patient in the prone position. A linear ultrasound transducer (PHILIPS Affiniti 50 color Doppler ultrasound device, Philips L12-5 50 mm linear array transducer) was placed in a longitudinal orientation 2.5-3 cm lateral to the T5-T6 spinous process. Three muscles were identified, and an 80-mm 21G block needle (Pajunk needle SonoPlex STIM 21x80 mm) was introduced in a cephalic-caudal position until its tip was inserted into the interfascial plane between the rhomboid major and erector spinae muscles. The injection was confirmed by observing a linear spread of the fluid (bilateral 20 mL 2.5%) at the targeted injection site. Preoperative single-shot bilateral ESP block was applied by AD and AO (Prof, MD), who have routinely applied ESP blocks in our clinic over the last three years.

Anaesthesia was administered intravenously with propofol (2-2.5 mg kg^{-1}), fentanyl (2 mg kg^{-1}), rocuronium (0.8 mg kg^{-1}), and lidocaine (1 mg kg^{-1}). General anaesthesia was maintained with inspiratory sevoflurane concentrations of 1.5-2.0%, titrated to achieve a BIS of 40-60, remifentanil infusion (0.05-0.25 mcg kg^{-1} min^{-1}) and intermittant rocuronium. The following intubation, a protective ventilation strategy was used by applying 7 mL kg^{-1} tidal volume and 5-8 cm H_2O positive end-expiratory pressure. A jugular central

venous catheter was inserted under ultrasound guidance. Following harvesting and adequate activated clotting time (>480 s), arterial and venous cannulation were performed, and CPB was initiated. CPB was performed with moderate hypothermia (28-31 °C) and alpha stat strategy. Hemoglobin concentrations were maintained above 7.5 g dL^{-1} and glucose levels were maintained under 200 mg dL^{-1} during operation, and 100 mg lidocaine and 1.5 g magnesium were administered prior to cross-clamp removal according to our institutional approach. At completion of CPB, heparin was replaced with protamine in a 1:1 ratio. Because of the short recovery time of sevoflurane and remifentanil, 0.5 mg kg^{-1} midazolam and 1 mg kg^{-1} tramadol were administered to the patients at the end of the operation. Paracetamol (1 g) was applied at sternal closing and repeated every 8 h. Following extubation, the severity of pain was assessed at rest and during movement using a 10-point numerical rating scale (NRS) for pain (0=no pain and 10=worst imaginable pain). Pain evaluation was performed based on all pain (sternum, saphenous and jugular regions, back, chest) in the 6th hour after extubation. In the setting of mild to severe postoperative pain (NRS for pain >4), a clinical bolus tramadol (1.5 mg kg^{-1}) was administered to the patient as a rescue analgesic. In the postoperative intensive care unit, patients with complete orientation and cooperation, no significant haemodynamic problems, spontaneous breathing and PaO_2 above 70 mmHg with 40% fractionated oxygen inhalation and no carbon dioxide retention were extubated. There was no duration of mechanical ventilation exceeding 8 h. The patients were extubated in 6-8 h and started oral intake 2 h following extubation. They were visited by a physiotherapist and dietician as soon as they were extubated to start respiratory exercises and to check if any additional nutritional support was needed. Major lines were removed 12 h after extubation, and the patients were transferred to the surgical wards. Demographic and intraoperative data were obtained. Preoperative anxiety was evaluated on a scale of 0-10 (NRS), and preoperative pain and anxiety were assessed on the day before surgery. Patient satisfaction in the postoperative period was also questioned on the first postoperative day, with 0 being "very dissatisfied" and 10 being "very satisfied".

Statistical Analysis

IBM SPSS.29.0 software was used for all data analysis. Descriptive statistics are presented as absolute numbers (n) and percentages (%) for categorical variables, the median-interquartile range (25^{th}-75^{th} percentiles) for non-normally distributed data, and the mean ± standard deviation for normally distributed data. The relationships between pre-operative pain/anxiety and postoperative pain were evaluated using Spearman's rho correlation analysis. $P < 0.05$ was considered statistically significant. The sample size of our study was determined by the number of patients in the specified date range. After the statistical analysis was completed, a post-hoc power analysis was performed. In IBM SPSS program, β was calculated 0.92 when the correlation coefficient of preoperative anxiety and postoperative pain was r=0.382, α=0.05 and n = 67.

Results

A total of 67 adult ERAS protocol patients who underwent elective cardiac surgery with CPB at our tertiary cardiac center were included from March 2023 to August 2023, and all patients were analyzed. The mean age of patients was 62.1 years, male gender was 80.6%, and body mass index was 28.45. Coronary artery bypass surgery was performed in 61% of the patients. The most frequent diseases were hypertension and diabetes mellitus (43%, 28%) (Table 1).

The rate of patients with a preoperative pain level NRS>4 was 1.5% and 1.5% at rest and with movement, respectively. In the postoperative period, pain >4 assessed by NRS was observed in 20.9% of patients at rest and 34.3% with movement and rescue analgesics were administered to these patients (Table 2).

Table 1. Demographic Data and Type of Surgery

	n = 67
Age (years), Mean ± SD	62.10±10.3
Gender (Female/Male), n (%)	13/54 (19.4/80.6)
Body mass index (kg m^{-2}), Mean ± SD	28.45±4.1
American Society of Anesthesiologists II/III/IV, n (%)	60/6/1 (89.6/9.0/1.5)
Left ventricular ejection fraction (%), Mean ± SD	54.14±8.6
Hypertension, n (%)	29 (43.3)
Diabetes mellitus, n (%)	19 (28.4)
Chronic obstructive pulmonary disease, n (%)	8 (11.9)
Chronic kidney disease, n (%)	4 (6)
Congestive heart failure, n (%)	3 (4.5)
Stroke/transient ischemic attack, n (%)	3 (4.5)
Type of Surgery, n (%)	
Coronary artery bypass grafting	41 (61.2)
Aortic valve replacement	8 (11.9)
Mitral valve replacement	7 (10.4)
Coronary artery bypass grafting and aortic valve replacement	7 (10.4)
Aortic valve and ascending aorta replacement	3 (4.5)
Aortic and mitral valve replacement	1 (1.5)

SD, standard deviation.

Table 2. Preoperative and Postoperative Pain, Anxiety and Patient Satisfaction			
Preoperative pain scores		**Postoperative pain scores**	
Resting NRS >4, n (%)	1 (1.5)	Resting NRS >4, n (%)	14 (20.9)
Mobilize NRS >4, n (%)	1 (1.5)	Mobilize NRS >4, n (%)	23 (34.3)
Preoperative anxiety scores		**Postoperative patient satisfaction scores**	
NRS 0, n (%)	44 (65.6)	NRS 2-6, n (%)	6 (8.9)
NRS 1-2, n (%)	10 (14.9)	NRS 7-8, n (%)	24 (35.8)
NRS 3-4, n (%)	8 (11.9)	NRS 9, n (%)	24 (35.8)
NRS 5-7, n (%)	5 (7.4)	NRS 10, n (%)	13 (19.4)
NRS, numeric rating scale.			

Table 3. Correlation of Preoperative Pain and Anxiety with Postoperative Pain	
	Postoperative pain score at rest, NRS (6th hours)
Preoperative pain score at rest, NRS	r=0.140 *P*=0.277
Preoperative anxiety score, NRS	r=0.382 *P*=0.003*
*$P < 0.05$. Spearman's Rho was used to the relationship between two variables. NRS, numeric rating scale.	

While no anxiety was detected in 65.6% of the patients, 34.3% had preoperative anxiety of grade 1 or above. The rate of patients with an anxiety level of NRS 5 was 7.5% (Table 2). In the patient satisfaction survey, 91.1% of patients were satisfied with the care provided (Table 2).

While there was no correlation between preoperative pain and postoperative pain in the patient by Spearman's rho test, it was determined that preoperative anxiety had a moderate correlation with postoperative pain (P=0.003), and as the severity of anxiety increased, the severity of postoperative pain also increased (Table 3).

Discussion

The ERAS protocol recommends pain management with detailed planning, perioperatively, multimodally, and often with non-opioid medications. It is mentioned that preoperative pain is often ignored in ERAS programs. In this study, we evaluated the frequency of preoperative pain in our cardiac surgery patients and found that the rate of patients with NRS ≥4 was only 1.5%. We also did not find any correlation between pre- and postoperative pain.

Questioning a patient's current preoperative pain levels can help optimize postoperative pain management. The patient's psychological state and dissatisfaction with previous hospital experiences are associated with a high risk of postoperative pain.[7] In addition, learning about a patient's initial pain and considering how to manage it preoperatively can help identify potential barriers. If there was a negative experience with pain management after a previous surgery, if the pain was not adequately resolved with a non-opioid pain prescription, or if there was chronic opioid use in the pre-operative period, these patients can be expected to experience more pain in the postoperative period. One study showed that the preoperatively operated knee had a greater response to suprathreshold heat stimuli than the other. Therefore, one of the causes of hyperalgesia in the affected knee is peripheral nerve sensitization caused by inflammation.[8] Before cancer surgery, the patient may experience pain depending on the location of the cancer, or the sadness caused by the cancer diagnosis may lower pain thresholds, which may also cause preoperative pain, similar to that in some orthopedic surgeries. However, it seems that preoperative pain is not a major issue demanding attention for cardiac surgery patients. In our clinic, ERAS application is used to provide information about the operation process, preoperative oral pregabalin is administered, and preoperative pain and anxiety assessments are performed. Accordingly, we believe that because very low and clinically insignificant preoperative pain is observed in the ERAS programs of cardiac patients who are already walking with great devotion, there is no need to make extra effort to detect this. Although preoperative chest pain may be more common in emergency cases, it is rare in elective cases.

In our results, a positive relationship was found between the severity of preoperative anxiety and postoperative pain. Although we aimed to reduce anxiety in our ERAS patients with pregabalin medication and information, 34.3% of the patients had anxiety NRS ≥1, and 7.5% of the patients had NRS ≥5. Although it is expected that a patient scheduled for heart surgery will be anxious considering the importance and magnitude of the surgery, it is clinically noteworthy that the severity of anxiety increases postoperative pain. In this case, it seems necessary to make more diverse interventions to relieve preoperative anxiety. The effort spent for this purpose is worth making as it can also contribute to postoperative pain relief. Studies have shown that

preoperatively anxious patients have higher postoperative pain.[9-11] High levels of preoperative anxiety can lead to intraoperative hemodynamic problems and increased need for analgesics.[11] The European Society of Anesthesiology guidelines recommend that anxiety assessment be included in pre-operative assessments.[12] One of the most validated and widely used instruments to evaluate preoperative anxiety in cardiac surgery is the state-trait anxiety inventory (STAI).[13] However, answering 40 state-reporting questions is time-consuming for the patient and doctor and may not always be done properly. In our study, instead of performing a detailed STAI test, we used the NRS scale, which patients can easily understand and will not take up much of the doctor's time. Even with this simple NRS scale setup, we could determine that preoperative anxiety was correlated with postoperative pain. Accordingly, in such a busy workload, simple NRS scoring could work quite well.

Conclusion

In this study, postoperative pain was assessed once at the time when it was expected to be most severe. However, monitoring and treatment procedures to provide analgesia were continued in clinical management. Advanced techniques, such as heat or electrical application, were not used to detect pain in the pre-operative period. Detailed psychic tests were not performed to evaluate anxiety. ERAS applications are already carried out with the dedication of many people, so this study aims to make evaluations with easy and practical methods.

Postoperative pain, which is an important prognostic marker after cardiac surgery, is a multifactorial and complex phenomenon. In our study, we found that preoperative pain does not seem to be a major problem in cardiac surgery patients and has no effect on postoperative pain. Therefore, we believe that the addition of multimodal pain management to the ERAS protocol may cause extra labor loss. However, we found that preoperative anxiety was associated with postoperative pain. We believe that preoperative regulation of a modifiable factor such as anxiety and implementation of personal interventions to reduce stress may improve outcomes.

Ethics Committee Approval: Ethical approval for this study was provided by the the Ankara City Hospital No. 1 Clinical Research Ethics Committee (approval no: E1-22-2613, date: 15.06.2022).

Informed Consent: Written informed consent was obtained.

Peer-review: Externally and internally peer-reviewed.

Author Contributions: Surgical and Medical Practices - A.A., N.S., A.Ö.; Concept - N.S., Z.A.D., A.F.E.; Design - Z.A.D., A.Ö., S.G.; Data Collection or Processing - A.A., N.S., A.F.E.; Analysis or Interpretation - A.A., A.F.E., S.G.; Literature Search - Z.A.D., A.Ö., S.G.; Writing - A.A., Z.A.D.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Bigeleisen PE, Goehner N. Novel approaches in pain management in cardiac surgery. *Curr Opin Anaesthesiol.* 2015;28(1):89-94. [CrossRef]
2. Joshi GP, Kehlet H. Postoperative pain management in the era of ERAS: An overview. *Best Pract Res Clin Anaesthesiol.* 2019;33(3):259-267. [CrossRef]
3. Lee B, Schug SA, Joshi GP, Kehlet H, PROSPECT Working Group. Procedure-speci fic pain management (PROSPECT)-An update. *Best Pract Res Clin Anaesthesiol.* 2018;32(2):101-111. [CrossRef]
4. Kashif M, Hamid M, Raza A. Influence of preoperative anxiety level on postoperative pain after cardiac surgery. *Cureus.* 2022;14(2):e22170. [CrossRef]
5. Gustafsson UO, Scott MJ, Hubner M, et al. Guidelines for perioperative care in elective colorectal surgery: enhanced recovery after surgery (ERAS®) society recommendations: 2018. *World J Surg.* 2019;43(3):659-695. [CrossRef]
6. Cogan J, Ouimette MF, Vargas-Schaffer G, Yegin Z, Deschamps A, Denault A. Patient attitudes and beliefs regarding pain medication after cardiac surgery: barriers to adequate pain management. *Pain Manag Nurs.* 2014;15(3):574-579. [CrossRef]
7. Zemła AJ, Nowicka-Sauer K, Jarmoszewicz K, Wera K, Batkiewicz S, Pietrzykowska M. Measures of preoperative anxiety. *Anaesthesiol Intensive Ther.* 2019;51(1):64-69. [CrossRef]
8. Martinez V, Fletcher D, Bouhassira D, Sessler DI, Chauvin M. The evolution of primary hyperalgesia in orthopedic surgery: quantitative sensory testing and clinical evaluation before and after total knee arthroplasty. *Anesth Analg.* 2007;105(3):815-821. [CrossRef]
9. Tai AL, Hsieh HF, Chou PL, Chen HM, Liu Y. The Influence of Preoperative Anxiety, Optimism, and Pain Catastrophizing on Acute Postoperative Pain in Patients Undergoing Cardiac Surgery: A Cross-sectional Study. *J Cardiovasc Nurs.* 2021;36(5):454-460. [CrossRef]
10. Choinière M, Watt-Watson J, Victor JC, et al. Prevalence of and risk factors for persistent postoperative nonanginal pain after cardiac surgery: a 2-year prospective multicentre study. *CMAJ.* 2014;186(7):E213-23. [CrossRef]
11. Theunissen M, Peters ML, Bruce J, Gramke HF, Marcus MA. Preoperative anxiety and catastrophizing: a systematic review and meta-analysis of the association with chronic postsurgical pain. *Clin J Pain.* 2012;28(9):819-841. [CrossRef]
12. De Hert S, Staender S, Fritsch G, et al. Pre-operative evaluation of adults undergoing elective noncardiac surgery: Updated guideline from the European Society of Anaesthesiology. *Eur J Anaesthesiol.* 2018;35(6):407-465. [CrossRef]
13. Zhou Z, Wang Y, Niu Y, et al. How we assess the perioperative anxiety of surgical patients with pulmonary nodules: the revision of state-trait anxiety inventory. *J Cardiothorac Surg.* 2020;15(1):324. [CrossRef]

DOI: 10.4274/TJAR.2023.231432

Original Article
Regional Anaesthesia

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):496-503

Scientific Publication Performance of the Erector Spinae Plane Block in Türkiye: A Bibliometric Analysis

Sibel Çatalca, Özlem Özmete, Nesrin Bozdoğan Özyılkan

Clinic of Anaesthesiology and Reanimation, Başkent University, Adana Dr. Turgut Noyan Application and Research Center, Adana, Turkey

Cite this article as: Çatalca S, Özmete Ö, Bozdoğan Özyılkan N. Scientific Publication Performance of the Erector Spinae Plane Block in Türkiye: A Bibliometric Analysis. *Turk J Anaesthesiol Reanim.* 2023;51(6):496-503.

Abstract

Objective: Erector spina plane block (ESPB) was first described in 2016 and is effective in various surgical procedures. Bibliometric analysis is a novel method that evaluates the contribution of scientific studies conducted in a specific field on the existing literature. This study examined articles on ESPB published by anaesthesia clinics in Türkiye in journals under the Science Citation Index Expanded (SCI-E) category.

Methods: Studies on ESPB indexed in the Web of Science Core Collection and published in Türkiye from 2018 to 2022 were evaluated. The primary outcome was to determine the number of studies published in journals under the SCI-E category. The secondary aims were to determine the number of citations and the institutions where the studies were conducted.

Results: A total of 159 publications were analyzed. The journal with the highest number of publications was "Journal of Clinical Anesthesia" (n = 70). The institution that has to date made the most contributions to the literature was Atatürk University (n = 31). The most cited article was "Ultrasound guided erector spinae plane block reduces postoperative opioid consumption following breast surgery: A randomized controlled study." published by Gürkan et al. (n = 175).

Conclusion: This study reflects the contribution level of Türkiye-addressed anaesthesia clinics to journals under the SCI-E category. Our findings can serve as a benchmark for attracting the attention of national and international researchers.

Keywords: Algology, bibliometrics, journal impact factor, pain, postoperative, regional anaesthesia

Main Points

- The erector spinae plane block (ESPB) has been a popular block in recent years.
- Bibliometric analysis is used to evaluate the contribution of published studies conducted in a specific field on the literature.
- The journal with the highest number of Türkiye-addressed publications on ESPB is the "Journal of Clinical Anaesthesia".
- The most cited Türkiye-addressed article on ESPB is "Ultrasound guided erector spinae plane block reduces postoperative opioid consumption following breast surgery: A randomized controlled study." published by Gürkan et al. (2018) in the Journal of Clinical Anesthesia.

Introduction

Erector spinae plane block (ESPB) provides analgesia in a large dermatomal area by injecting a local anaesthetic agent into the space between the vertebral transverse process and the erector spinae muscle. It has become exceedingly popular in recent years because of its effectiveness, easy application, and low complication rate. ESPB was first performed by Foreo in 2016 in two patients with thoracic neuropathic pain and rib fractures.[1] Anatomical

Corresponding author: Sibel Çatalca, e-mail: drsibelcatalca@gmail.com

Received: September19, 2023 Accepted: November 21, 2023

and radiological studies performed on fresh cadavers have demonstrated that ESPB affects the dorsal and ventral nerve branches in the spinal medulla.[2] Due to its spread of approximately 3-4 segments cranially and caudally from the site of administration, ESPB has been increasingly used in postoperative pain management and the treatment of neuropathic pain in various procedures. ESPB can be performed at the lumbar, thoracic, cervical, and sacral vertebrate levels.[2-6]

Bibliometric analysis (BA) is a novel method that examines the contribution of scientific studies published in a specific field to the literature through statistical and visual analysis.[7] In BAs involving medical areas, databases such as Web of Science (WoS), Scopus, Cochrane Library, PubMed, and Google Scholar are frequently used for the evaluation and measurement of scientific outputs.[8-10] One of the important criteria used in this analysis is the citation count. As an article's citation increase, its impact on the respective field also grows.[11,12]

In recent years, BAs related to anaesthesia have been conducted to assess the contributions and citation counts of publications, authors, institutions, journals, and countries.[8,13] Several BAs have also previously been performed on regional anaesthesia.[9,14] However, there is an extremely limited number of BAs that have focused on ESPB.[15] No analysis evaluating scientific studies from Türkiye on ESPB and published in high-impact factor journals listed in international indexes has been found. Assessing the current situation in Türkiye is necessary for developing research and training institutions. Determining the most cited articles and high-impact factor journals may help researchers review Türkiye-addressed literature and identify new directions while planning future studies. This study evaluated articles on ESPB published by anaesthesia clinics in Türkiye in journals categorized under the Science Citation Index Expanded (SCI-E).

Methods

The study protocol was approved by the Başkent University Institutional Review Board (approval no: KA23/150). In this study, we collected articles published by anaesthesiologists in Türkiye that focused on ESPB up to 2022 as a data source. The "advanced search" feature of the WoS database was used to identify relevant publications (https://www.webofscience.com/wos/woscc/advanced-search, access date 25.04.2023). A comprehensive search was performed using the terms "erector spinae plane block" or "erector spina plane block" to determine publications from Türkiye. Documents published in journals in the SCI-E category up to December 31, 2022 were filtered. Journals outside the SCI-E category and publications from 2023 were excluded from the analysis. The full search query was as follows: [ALL=(erector spina plane block) or ALL=(erector spinae plane block)) and ADDRESS=(Turkey) I Time span: 2016-01-01 to 2022-12-31 (Publication Date)]. After reading the abstracts of the retrieved publications, those that were not related to ESPB and excluded an anaesthetist in the author list were excluded.

All data were exported to a Microsoft Excel (2003 version) table, including the publication title, publication year, type of publication registered in WoS (article, editorial, letter to the editor, review, conference abstract), the journal in which the article was published, authors' institutions, cited references in Türkiye-addressed publications, and keywords and citation numbers in WoS. Based on the abstracts, publications that were case reports were categorized as "case report/series", while publications that involved critiques of articles were categorized as "letter to the editor". This reclassification was performed according to the content of the publication type, such as case report/series, letter to the editor, review, cadaver study, retrospective study, and randomized controlled study (RCT). Considering the age of the published article, the annual average number of citations was calculated. The 2021 Journal Impact Factors (JIF) were obtained from the Thomson Reuters InCites database (access date 30.4.2023, https://jcr.clarivate.com/jcr/browse-journals). The institution of the first-listed anaesthetist was accepted as the "institution of the first author". Each article was examined individually to determine the type of pain affected by ESPB (postoperative pain, neuropathic pain), the surgical procedure, the level of the block (cervical, thoracic, lumbar, or sacral), and the vertebral level at which ESPB was applied.

The primary outcome was to determine the number of studies published in journals under the SCI-E category. The secondary aims were to define publication year, publication type, institutions, keywords, number of citations, type of pain affected by ESPB, surgical procedure, level of block that had been performed, and most frequently cited references in the publications.

The Excel program was used for the mathematical and visual analyses. Visual analysis of the top 19 most cited references in Türkiye-addressed publications, as well as keywords that were used at least five times, was performed using the VOSviewer program (version 1.6.19).

Results

A total of 220 results related to ESPB in Türkiye were obtained from the WoS database. Among these, 54 publications had not been published in journals in the SCI-E category, 5 were irrelevant to the topic, and 2 were excluded due to no anaesthetists affiliated with Turkish institutions in the author list. Finally, 159 publications met all the criteria for inclusion in the study (Figure 1).

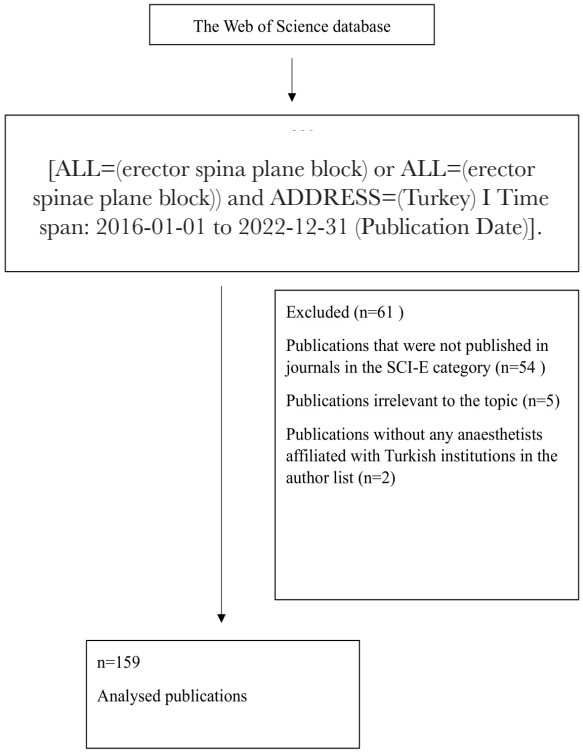

Figure 1. Consort diagram

The 159 publications included in the analysis were published in 46 different journals within the SCI-E category. The list of journals in which the studies were published, JIFs, total number of publications in the journals, number of WoS citations, and average citations per publication are presented in Table 1.

It was observed that among the publications in the WoS, 56.6% (n = 90) were in the form of letters to the editor, 37.7% (n = 60) were articles, 3.1% (n = 5) were reviews, 1.2% (n = 2) were editorials, and 1.2% (n = 2) were in the conference abstract category. When the abstracts of the articles were analyzed to determine the type of publication, 47.7% (n = 76) were case reports/series, 27.6% (n = 44) were RCTs, 14.4% (n = 23) were letters to the editor providing criticism/contribution/response to previous studies, 4.4% (n = 7) were retrospective studies, 3.1% (n = 5) were reviews, 1.2% (n = 2) were conference abstracts, 0.6% (n = 1) was cadaver study, and 0.6% (n = 1) was an editorial.

ESPB was applied to patients for pain management in 128 of the 159 publications. It was performed in 111 publications on adult patients, 16 publications on paediatric patients, and 1 publication on both patient groups. When analyzing the vertebral levels at which ESPB was performed, it was found to have been applied at the thoracic level in 98 publications, the lumbar level in 28 publications, and the sacral level in 5 publications. ESPB was used for acute pain management in 94.53% (n = 121) and chronic pain management in 5.78% (n = 7) of these publications.

When analyzing publications related to acute pain management, ESPB was found to have been performed for intraoperative/postoperative pain management in 94.21% of the publications (n = 114), for acute pain management in patients with active Zona Zoster in 3.3% (n = 4), for pain management in the emergency department (renal colic) in 1.65% (n = 2), and for pain management in the intensive care unit (rib fracture) in 0.82% (n = 1). The interventions and vertebral levels at which ESPB was performed for intraoperative/postoperative analgesia are shown in Table 2.

When analyzing publications related to chronic pain management, ESPB was observed to have been performed for the following procedures: myofascial pain syndrome (n = 3), neuropathic pain related to thoracicgynecological and urological malignancies (n = 3), post-herniorrhaphy neuralgia (n = 1), and chronic lumbar disk pain (n = 1).

When examining the annual distribution of the publications, this study found that 10% (n = 16) of the publications were published in 2018, 31.1% (n = 50) in 2019, 22.6% (n = 36) in 2020, 13.2% (n = 21) in 2021, and 22.6% (n = 36) in 2022.

The institution that has made the most contributions to the literature on ESPB in Türkiye to date is Atatürk University (n = 31). This was followed by Maltepe University (n = 27), Kocaeli University (n = 19), Koç University (n = 10), and Medipol University (n = 10). When we reanalyzed the institutions linked to these publications according to the affiliation of the first author, Atatürk University was found to have the highest number of publications in the SCI-E category related to ESPB (n = 18) with a first author (Table 3).

When the citation numbers of the publications were evaluated, it was observed that 159 publications received 2065 citations according to the WoS database. The most cited article was "Ultrasound-guided erector spinae plane block reduces postoperative opioid consumption following breast surgery: A randomized controlled study." published by Gürkan et al.[4] in the Journal of Clinical Anesthesia (n = 175). The top 10 most cited publications, the number of citations in the WoS database, and the annual average number of citations are shown in Table 4.[4,16-23]

Table 1. Journals in the Science Citation Index Expanded Category with Publications from Türkiye, Their 2021 Impact Factors, Total Number of Publications in the Journals, the Number of Web of Science Citations, and Average Citations Per Publication

Journal	2021 JIF	TN	C	C/TN
Journal of Thoracic Oncology	20.121	1	0	0
British Journal of Anaesthesia	11.719	1	15	15
Journal of Clinical Anesthesia	9.375	70	1217	17,38
Anaesthesia Critical Care & Pain Medicine	7.025	3	58	19,33
Canadian Journal of Anesthesia	6.713	3	22	7,33
Anesthesia and Analgesia	6.627	1	0	0
Regional Anesthesia and Pain Medicine	5.564	7	85	12,14
American Journal of Emergency Medicine	4.093	6	55	9,16
American Journal of Translational Research	3.940	1	0	0
Pain Medicine	3.637	4	41	10,25
Minerva Anestesiologica	3.396	7	124	17,71
Spine	3.269	1	6	6
Journal of Anesthesia	2.931	2	9	4,5
Journal of Cardiothoracic and Vascular Anesthesia	2.894	4	98	24,5
Aesthetic Plastic Surgery	2.708	5	30	6
BMC Anesthesiology	2.376	5	48	9,6
Acta Anaesthesiologica Scandinavica	2.274	1	8	8
World Neurosurgery	2.210	4	88	22
Journal of Clinical Monitoring and Computing	1.977	1	3	3
Revista Brasileira de Anestesiologia*	1.098	4	18	4,5
Anaesthesist	1.052	1	19	19
Journal of Investigative Surgery	1.97	1	8	8
Expert Opinion on Drug Metabolism & Toxicology	4.93	1	0	0
Turkish Journal of Medical Sciences	2.92	2	0	0
Annals of Palliative Medicine	1.92	1	1	1
Journal of Pain Research	2.83	1	54	54
Sao Paulo Medical Journal	1.83	1	1	1
Journal of Ultrasound in Medicine	2.75	1	4	4
Journal of Laparoendoscopic & Advanced Surgical Techniques	1.76	1	10	10
Thoracic and Cardiovascular Surgeon	1.75	1	0	0
Indian Journal of Surgery	1.75	1	0	0
European Spine Journal	2.72	1	5	5
Journal of Endourology	2.61	1	16	16
Perfusion-UK	1.58	1	0	0
Journal of International Medical Research	1.57	1	0	0
Acta Orthopaedica et Traumatologica Turcica	1.55	1	0	0
Journal of Cardiothoracic Surgery	1.52	1	2	2
Obesity Surgery	3.47	1	3	3
Saudi Medical Journal	1.42	1	0	0
Current Opinion in Critical Care	3.35	1	3	3
General Thoracic And Cardiovascular Surgery	1.22	1	5	5
International Journal of Clinical Practice	3.14	1	6	6
Nigerian Journal of Clinical Practice	1.12	1	0	0
Journal of Thoracic Disease	3.00	1	0	0
Journal of The College of Physicians and Surgeons Pakistan	1.02	1	1	1
Brazilian Journal of Anesthesiology*	*	2	2	1

*In 2021, Revista Brasileira de Anestesiologia underwent a name change and is now known as "Brazilian Journal of Anesthesiology".
JIF, journal impact factor; TN, total number of publications; C, the number of Web of Science citations; C/TN, average citations per publication.

Table 2. The Interventions and the Vertebra Levels in Which Erector Spinae Plane Block was Performed for Intraoperative/ Postoperative Analgesia

Intervention	Vertebral level	Intervention	Vertebral level
Scoliosis surgery	T4-10	Thyroidectomy and neck dissection	T1
Posterior lumbar instrumentation, decompression, lumbar fracture	T10, T12-L5, L3	Esophageal surgery	T4
Lumbar disc	L4	Cardiopulmonary bypass	T4, T5
Knee replacement	L4	Video-assisted thoracic surgery, thoracotomy	T4, T5, T6
Shoulder surgery	T2	Excision of masses from ribs	T5
Scapula surgery	T2-T5	Chest tube insertion	T6, T7
Distal Humerus surgery	T2	Breast surgery	T3, T4, T5
Hip surgery	L4, S1	Laparoscopic cyst hydatid surgery	L2, L3
Radical prostatectomy	T11, T12	Laparoscopic/open cholecystectomy	T7, T8, T9
Cesarean section	T10, T11	Peritonitis	T7
Ureterocele	L1-2	Liver surgery	T8
Laparoscopic varicocele	T11	Appendectomy	T7, T8, T9
Orchiopexy	T12-L2	Inguinal hernia	Lumbar lateral position
Gender reassignment (bottom procedure)	T7	Laparoscopic bariatric surgery	T9
Hypospadias	S4	Abdominoplasty	L1
Anoplasty	S4	Ileostomy closure	T8
Pilonidal sinus	S2	Duodenal atresia	T8
Labour pain	T11	Renal transplantation	T9
		Nephrectomy	T9, T10, T12

Table 3. The Institutions Where the First Author Works and the Number of Publications of These Institutions

Institution	NP
Ataturk University	18
Maltepe University	16
Kocaeli University	16
Mugla Sitki Kocman University	9
Medipol University	8
Izmir Cigli Training and Research Hospital	6
Kirsehir Ahi Evran University	6
Ondokuz Mayis University	5
Necmettin Erbakan University	5
Kutahya University of Health Sciences	4
Aydin Adnan Menderes University	4
Kahramanmaras Sutcu Imam University	4
Koc University	4
Kocaeli Derince Training and Research Hospital	4
Erzurum Region Training and Research Hospital	4
American Hospital	3
Kutahya Dumlupinar University	3
Erciyes University	3
Marmara University	3
Ankara Ataturk Sanatorium Training and Research Hospital	2
Istanbul Bakirkoy Dr. Sadi Konuk Training and Research Hospital	2
Ankara Diskapi Yildirim Beyazit Training and Research Hospital	2
Erzincan Binali Yıldırım University	2
Istanbul University	2
Sakarya University	2
Abdulkadir Yuksel State Hospital	1
Ankara City Hospital	1
Ankara University	1
Baskent University	1
Bezmialem University	1
Bingol State Hospital	1
Bulent Ecevit University	1
Cukurova University	1
Firat University	1
Gulhane Faculty of Medicine	1
Istanbul Sisli Hamidiye Etfal Training and Research Hospital	1
Kirikkale University	1
Konya Anit Hospital	1
Konya Training and Research Hospital	1
Konya City Hospital	1
Maltepe State Hospital	1
Tekirdag Namik Kemal University	1
Samsun Training and Research Hospital	1
Tatvan State Hospital	1
Uludag University	1
Bursa Yuksek Ihtisas Training and Research Hospital	1
Bursa City Hospital	1
Total	**159**

NP, number of publications.

Table 4. The Top 10 Most Cited Publications, the Number of Citations in the Wos Database and the Annual Average Citation Numbers

No	Publication	WoS citation count	Average annual citation count
1	Gürkan et al.[4], Journal of Clinical Anesthesia, 2018	175	30.6
2	Tulgar et al.[5], Journal of Clinical Anesthesia, 2018	108	19.6
3	De Cassai et al.[17], (Tulgar S), Minerva Anestesiology, 2019	106	21.4
4	Altıparmak et al.[18], Journal of Clinical Anesthesia, 2019	95	19.8
5	Tulgar et al.[16], Journal of Clinical Anesthesia, 2018	80	14.8
6	Gurkan et al.[19], Journal of Clinical Anesthesia, 2020	76	19.2
7	Yayik et al.[20], World Neurosurgery, 2019	67	14.4
8	Altıparmak et al.[21], Journal of Clinical Anesthesia, 2019	66	14
9	Ciftci et al.[22], Journal of Cardiothoracic and Vascular Anesthesia, 2020	65	17.2
10	Tulgar et al.[23], Journal of Clinical Anesthesia, 2018	59	11.3

WoS, Web of Science.

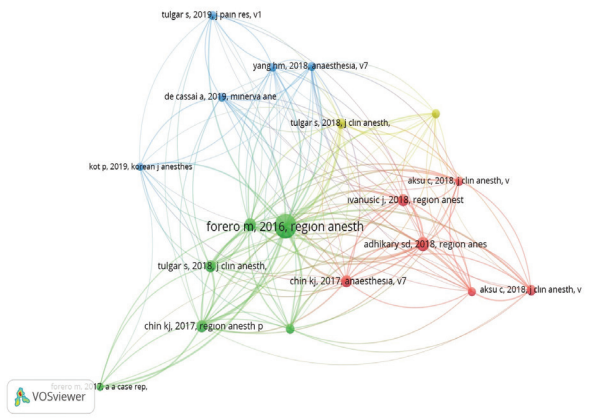

Figure 2. The visual analysis of the top 19 most frequently cited references in Türkiye-addressed publications was created using the VOSviewer program. (Footnote: Each circle is demonstrated by the first author, the year of publication, and the journal in which the cited article was published. The size of the circle is indicated by the number of citations. Colours indicate clustering in the field of erector spinae plane block. The thickness of the lines is related to the co-citations.)

A total of 1283 sources were used in 159 publications. Among these publications, the number of references cited at least 10 times was 19, and the number of references cited at least 20 times was 7. Figure 2 presents a visual analysis of the top 19 most frequently cited references in Türkiye-addressed publications (created using the VOSviewer program). The most cited publications are Forero et al.[1] (n = 89), Adhikary et al.[24] (n = 29), Gürkan et al.[4] (n = 23), Chin et al.[25] (n = 22), Chin et al.[26] (n = 21), Tulgar et al.[16] (n = 20), and Ivanusic et al.[27] (n = 20).

When the keywords were analyzed, 189 different keywords were identified. It was found that 12 keywords were used 5 or more times and "erector spinae plane block" was the most frequently used keyword (n = 52). Other keywords that were used 5 or more times were postoperative analgesia (n = 26), postoperative pain (n = 15), ultrasound (n = 14), analgesia (n = 13), nerve block (n = 8), pain (n = 8), regional anaesthesia (n = 7), pediatric anaesthesia (n = 6), ultrasonography (n = 6), laparoscopic cholecystectomy (n = 5), and pain management (n = 5).

Discussion

In this study, Türkiye-addressed publications were identified using the keywords "erector spina plane block" or "erector spinae plane block". According to the results of our research, the journal with the highest number of Türkiye-addressed publications was the Journal of Clinical Anesthesia. The institution that has made the largest contribution to the literature to date was Atatürk University (n = 31). The most cited publication was an article titled "Ultrasound-guided erector spinae plane block reduces postoperative opioid consumption following breast surgery: A randomized controlled study." by Gürkan et al.[4] (n = 175).

In recent years, BAs have become a frequently used method to determine the number and quality of published studies.[7,8] Chen et al.[28] which researched the global distribution of studies on anaesthesiology, it was reported that Türkiye ranks seventh worldwide in terms of the number of RCTs published in journals in the SCI-E category (n = 671, 4.78%). Another study emphasized that a country's level of economic development was set as an important factor in the number of available publications. However, countries such as Türkiye, China, and India have made significant

contributions to the literature on anaesthesiology.[29] Similar to the topic of anaesthesiology Türkiye has made a significant contribution to the literature on regional anaesthesia. In a recent study, Kayir and Kisa[9] analyzed publications on regional anaesthesia between 1980 and 2019 using the WoS database. The authors reported that the countries with the highest number of articles on regional anaesthesia were the United States (n = 1,583), Germany (n = 585), England (n = 510) and Türkiye (n = 386).

After conducting a literature review, the present study found only one BA related to ESPB. In this analysis, Huang et al.[15] Evaluated articles published in journals in the SCI-E category between 2016 and July 2022. Similar to our research, this study used WoS as a database. A total of 762 articles were found in this analysis, and Türkiye ranked third (n = 56) after the United States and China, with Atatürk University ranking fourth (n = 10) worldwide in terms of the number of articles. In this BA, similar to our study's results, the most frequently used keywords were erector spinae plane block, postoperative analgesia, pain management, and postoperative pain. These findings suggest that Turkish anaesthetists used shared keywords and terminology similar to those used in the global literature.

According to the results of our study, the journals with the highest number of publications on ESPB from Türkiye included the Journal of Clinical Anesthesia, Regional Anesthesia and Pain Medicine, and Minerva Anestesiologica. The journals with the highest number of citations per article were the Journal of Pain Research, Journal of Cardiothoracic and Vascular Anesthesia, World Neurosurgery, Anaesthesia Critical Care & Pain Medicine, and Anaesthesist. It is recommended that authors who wish to publish their studies on ESPB in journals with high JIF and to receive more citations should consider these journals as their first choice.

When publications were analyzed based on the total number of citations, the article with the highest number of citations was identified as an RCT published in the "Journal of Clinical Anesthesia" (n = 175).[4] Furthermore, this article had the highest annual average number of citations (30.6%). When examining the references cited in the publications, Forero et al.[1] (n = 89), Adhikary et al.[24] (n = 29), Gürkan et al.[4] (n = 23), Chin et al.[25] (n = 22), Chin et al.[26] (n = 21), Tulgar et al.[16] (n = 20), and Ivanusic et al.[27] (n = 20) were identified as the publications with the highest number of citation. Therefore, we suggest that anaesthetists interested in ESPB research should first review these studies.

In this study, the first publication on ESPB from Türkiye was published in 2018.[5] While the number of publications showed an increasing trend in the first 2 years of the observed period, a significant decrease was detected in 2020. A similar publication curve plot was also available in BA on ESPB published by Huang et al.[15]. We believe that this decrease was likely due to the outbreak of the global coronavirus pandemic.

Study Limitations

Our study has some limitations. First, the literature search was limited to WoS, and other databases such as Cochrane, PubMed, Google Scholar, and Scopus were not evaluated. Second, only publications in journals in the SCI-E category were included in our study. Publications in journals outside the SCI-E category and in groups such as books and book chapters were not analyzed. Finally, we excluded publications authored by non-anaesthetists.

Conclusion

This study provides a detailed evaluation of the most influential studies conducted in Türkiye on ESPB. Our findings can help researchers interested in this type of block better understand the situation and identify new directions for future research.

Ethics Committee Approval: Ethical clearance was given by the Başkent University Institutional Review Board (approval no: KA23/150).

Informed Consent: Not required.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - S.Ç.; Design - S.Ç.; Data Collection or Processing - S.Ç.; Analysis or Interpretation - S.Ç., Ö.Ö.; Literature Search - S.Ç., Ö.Ö.; Writing - S.Ç., Ö.Ö., N.B.Ö.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Forero M, Adhikary SD, Lopez H, Tsui C, Chin KJ. The Erector Spinae Plane Block: A Novel Analgesic Technique in Thoracic Neuropathic Pain. *Reg Anesth Pain Med*. 2016;41(5):621-627. [CrossRef]
2. El-Boghdadly K, Pawa A. The erector spinae plane block: plane and simple. *Anaesthesia*. 2017;72(4):434-438. [CrossRef]
3. Ma D, Wang R, Wen H, Li H, Jiang J. Cervical erector spinae plane block as a perioperative analgesia method for shoulder arthroscopy: a case series. *J Anesth*. 2021;35(3):446-450. [CrossRef]
4. Gürkan Y, Aksu C, Kuş A, Yörükoğlu UH, Kılıç CT. Ultrasound guided erector spinae plane block reduces postoperative opioid consumption following breast surgery: A randomized controlled study. *J Clin Anesth*. 2018;50:65-68. [CrossRef]

5. Tulgar S, Senturk O. Ultrasound guided Erector Spinae Plane block at L-4 transverse process level provides effective postoperative analgesia for total hip arthroplasty. *J Clin Anesth.* 2018;44:68. [CrossRef]
6. Kukreja P, Deichmann P, Selph JP, Hebbard J, Kalagara H. Sacral Erector Spinae Plane Block for Gender Reassignment Surgery. *Cureus*. 2020;12(4)e7665. [CrossRef]
7. Chen C, Song M. Visualizing a field of research: A methodology of systematic scientometric reviews. *PLoS One*. 2019;14:e0223994. [CrossRef]
8. Ratnayake G, El-Boghdadly K, Pandit JJ. An analysis of the academic capacity of anaesthesia in the UK by publication trends and academic units. *Anaesthesia*. 2021;76(4):500-513. [CrossRef]
9. Kayir S, Kisa A. The evolution of the regional anesthesia: a holistic investigation of global outputs with bibliometric analysis between 1980-2019. *Korean J Pain*. 2021;34(1):82-93. [CrossRef]
10. Kokol P, Vošner HB. Discrepancies among Scopus, Web of Science, and PubMed coverage of funding information in medical journal articles. *J Med Libr Assoc.* 2018;106(1):81-86. [CrossRef]
11. Li C, Ojeda-Thies C, Xu C, Trampuz A. Meta-analysis in periprosthetic joint infection: a global bibliometric analysis. *J Orthop Surg Res*. 2020;15(1):251. [CrossRef]
12. Khan FR, Raza Kazmi SM, Siddiqui YF. A bibliometric analysis of the studies on dental implant failure. *J Pak Med Assoc*. 2022;72(Suppl 1):S76-S80. [CrossRef]
13. Yılmaz HO, Babazade R, Turan OA, Babazade B, Koyuncu O, Turan A. Scientific Publication Performance of Turkish Anaesthesia Clinics in High Impact Factor International Journals Between 2005 and 2014: A Bibliometric Analysis. *Turk J Anaesthesiol Reanim*. 2017;45(1):16-25. [CrossRef]
14. Shbeer A. Regional Anesthesia (2012-2021): A Comprehensive Examination Based on Bibliometric Analyses of Hotpots, Knowledge Structure and Intellectual Dynamics. *J Pain Res.* 2022;15:2337-2350. [CrossRef]
15. Huang X, Sandeep B, Yang J. Mapping structural and research trends in surgical use of ultrasound-guided erector spinae plane block: A bibliometric analysis - Correspondence. *Int J Surg*. 2022;106:106904. [CrossRef]
16. Tulgar S, Kapakli MS, Senturk O, Selvi O, Serifsoy TE, Ozer Z. Evaluation of ultrasound-guided erector spinae plane block for postoperative analgesia in laparoscopic cholecystectomy: A prospective, randomized, controlled clinical trial. *J Clin Anesth*. 2018;49:101-106. [CrossRef]
17. De Cassai A, Bonvicini D, Correale C, Sandei L, Tulgar S, Tonetti T. Erector spinae plane block: a systematic qualitative review. *Minerva Anestesiol*. 2019;85(3):308-319. [CrossRef]
18. Altıparmak B, Korkmaz Toker M, Uysal Aİ, Turan M, Gümüş Demirbilek S. Comparison of the effects of modified pectoral nerve block and erector spinae plane block on postoperative opioid consumption and pain scores of patients after radical mastectomy surgery: A prospective, randomized, controlled trial. *J Clin Anesth*. 2019;54:61-65. [CrossRef]
19. Gürkan Y, Aksu C, Kuş A, Yörükoğlu UH. Erector spinae plane block and thoracic paravertebral block for breast surgery compared to IV-morphine: A randomized controlled trial. *J Clin Anesth*. 2020;59:84-88. [CrossRef]
20. Yayik AM, Cesur S, Ozturk F, et al. Postoperative Analgesic Efficacy of the Ultrasound-Guided Erector Spinae Plane Block in Patients Undergoing Lumbar Spinal Decompression Surgery: A Randomized Controlled Study. *World Neurosurg*. 2019;126:e779-e785. [CrossRef]
21. Altıparmak B, Korkmaz Toker M, Uysal AI, Kuşçu Y, Gümüş Demirbilek S. Ultrasound-guided erector spinae plane block versus oblique subcostal transversus abdominis plane block for postoperative analgesia of adult patients undergoing laparoscopic cholecystectomy: Randomized, controlled trial. *J Clin Anesth*. 2019;57:31-36. [CrossRef]
22. Ciftci B, Ekinci M, Celik EC, Tukac IC, Bayrak Y, Atalay YO. Efficacy of an Ultrasound-Guided Erector Spinae Plane Block for Postoperative Analgesia Management After Video-Assisted Thoracic Surgery: A Prospective Randomized Study. *J Cardiothorac Vasc Anesth*. 2020;34(2):444-449. [CrossRef]
23. Tulgar S, Selvi O, Senturk O, Ermis MN, Cubuk R, Ozer Z. Clinical experiences of ultrasound-guided lumbar erector spinae plane block for hip joint and proximal femur surgeries. *J Clin Anesth*. 2018;47:5-6. [CrossRef]
24. Adhikary SD, Bernard S, Lopez H, Chin KJ. Erector Spinae Plane Block Versus Retrolaminar Block: A Magnetic Resonance Imaging and Anatomical Study. *Reg Anesth Pain Med*. 2018;43(7):756-762. [CrossRef]
25. Chin KJ, Malhas L, Perlas A. The Erector Spinae Plane Block Provides Visceral Abdominal Analgesia in Bariatric Surgery: A Report of 3 Cases. *Reg Anesth Pain Med*. 2017;42(3):372-376. [CrossRef]
26. Chin KJ, Adhikary S, Sarwani N, Forero M. The analgesic efficacy of pre-operative bilateral erector spinae plane (ESP) blocks in patients having ventral hernia repair. *Anaesthesia*. 2017;72(4):452-460. [CrossRef]
27. Ivanusic J, Konishi Y, Barrington MJ. A Cadaveric Study Investigating the Mechanism of Action of Erector Spinae Blockade. *Reg Anesth Pain Med.* 2018;43(6):567-571. [CrossRef]
28. Chen QB, Yang HY, Chen DS, Lv YW, Hu LH, Yuan HB. Global distribution of publications in anesthesiology: A bibliometric analysis from 1999 to 2018. *Anaesthesist*. 2021;70(10):854-862. [CrossRef]
29. Doğan G, Karaca O. Análise bibliométrica no campo da anestesiologia no período de 2009-2018 [A bibliometric analysis of the field of anesthesia during 2009-2018]. *Braz J Anesthesiol.* 2020;70(2):140-152. [CrossRef]

DOI: 10.4274/TJAR.2023.231470

Original Article

Pain

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):504-509

Parasagittal Interlaminar and Transforaminal Epidural Steroid Injections for Radicular Low Back Pain; Which is More Comfortable?

Gevher Rabia Genç Perdecioğlu, Gökhan Yıldız, Ömer Taylan Akkaya, Ezgi Can, Damla Yürük

Ankara Etlik City Hospital, Clinic of Algology, Ankara, Turkey

Cite this article as: Genç Perdecioğlu GR, Yıldız G, Akkaya ÖT, Can E, Yürük D. Parasagittal Interlaminar and Transforaminal Epidural Steroid Injections for Radicular Low Back Pain; Which is More Comfortable?. *Turk J Anaesthesiol Reanim.* 2023;51(6):504-509.

Abstract

Objective: This study aimed to compare parasagittal interlaminar (PS) and transforaminal (TF) epidural steroid injections for unilateral L5 and S1 radicular lower back pain in terms of patient comfort, efficacy, safety, contrast enhancement, and radiation exposure.

Methods: This was a prospective randomized single-blind study. A total of 59 participants were included in this study. The visual analog scale (VAS) and Oswestry Disability Index (ODI) were obtained. A comfort questionnaire was administered to all participants. The total fluoroscopy time and contrast distribution levels were recorded.

Results: Pre- and post-treatment VAS scores were similar between the groups. The ODI scores increased in favor of the PS group at week 2 ($P < 0.041$); however, there was no difference between the two groups at other times. The VAS and ODI scores improved significantly with treatment in both the groups ($P < 0.001$). Total fluoroscopy time was shorter in the PS group ($P < 0.001$). PS application was more comfortable ($P < 0.001$). While no complications were observed in the PS group, three complications occurred in the TF group. Anterior epidural contrast spread to three or more levels was observed in 57% of the participants in the PS group, whereas no spread to more than two levels was observed in the TF group.

Conclusion: The PS epidural approach is superior to the TF approach in terms of a low incidence of side effects, less radiation exposure, better patient comfort, higher epidural contrast spread, and single-level needle access.

Keywords: Algology, epidural steroid injection, pain, parasagittal interlaminar, transforaminal epidural

Main Points

- In our study, parasagittal epidural steroid injection was superior to the transforaminal method for the treatment of radicular low back pain at week 2 and similar efficacy at week 4.
- Total radiation dose, side effects, and patient comfort were superior to transforaminal.
- Our aim was to analyze the advantages and disadvantages of methods with similar efficacy. The parasagittal approach seems to be more useful than the transforaminal approach.

Introduction

One of the most common causes of chronic low back pain is a herniated disc.[1] Radicular is caused by inflammation of herniated disc material in the epidural space. It is treated with epidural steroids, especially dexamethasone.[2-4] Epidural steroid injections can be performed using caudal, transforaminal, midline, and parasagittal interlaminar approaches.

Previous studies have compared these methods in terms of treatment efficacy, contrast spread, and side effects. Many reports suggest that treatment efficacy is superior for PS and TF interventions than for caudal and midline interlaminar epidural approaches.[5-8]

Corresponding author: Gevher Rabia Genç Perdecioğlu, e-mail: gevhergenc@gmail.com

Received: November 11, 2023 Accepted: December 11, 2023

However, there is no clear answer as to which of these two methods is preferable. The effectiveness of the parasagittal interlaminar (PS) and transforaminal (TF) approaches has generally been found to be similar.[6,9-11] In terms of safety, in contrast to the benign nature of the PS approach, the TF approach appears to have a higher risk of complications because of its proximity to the radicular medullary artery and nerve root.[8,10,12-15] Authors have different opinions on contrast distribution and fluoroscopy time.[6-8]

In this study, we compared the TF and PS methods for radicular low back pain due to L4-L5 and L5-S1 posterolateral disc herniation. We aimed to determine the superiority of these two techniques in terms of safety, total radiation exposure, patient comfort, and contrast enhancement.

Methods

Study Design and Population

This was a prospective, randomized, controlled clinical trial. Ethics Committee approval was obtained from the University of Health Sciences Turkey, Dışkapı Yıldırım Beyazıt Training and Research Hospital Ethics Committee, and we are affiliated with and registered in Clinical Research (date: 07.03.2022, approval no: 132/10, Clinical Trial Number: NCT05551676).

Between August 2022 and January 2023, 123 patients with unilateral radicular low back pain were assessed. Of the 123 patients who met the inclusion criteria, 59 were included in the study. The participants underwent treatment in the Department of Algology. The inclusion criteria were as follows: 1) age 20-60 years; 2) radiologically proven L4-L5 and L5-S1 protruded/extruded discs with radicular symptoms; and 3) >3 months of pain that did not respond to conservative treatment. The exclusion criteria were as follows: 1) migrated disc or spinal stenosis (anteroposterior spinal canal diameter less than 12 mm on lumbar magnetic resonance images); 2) previous lumbar surgery or algological procedure; 3) indication for emergency surgery for discopathy; 4) malignancy, pregnancy, or other rheumatological/neurological diseases; and 5) no contrast spread to the anterior epidural space and target nerve roots during the procedure.

We used a computer-assisted randomization program to categorize the patients into two groups: the PS group was assigned number 1, and the TF group was assigned number 2. The sample size was based on the primary outcomes and calculations using G*Power 3.1.9.4 software, with an effect size of 0.617, α=0.05, and power (1-β) =0.80.[16,17] A total of 40 subjects were included in each group. Kaur's third-month visual analog scale (VAS) scores [mean and standard deviation (SD)] were obtained for this analysis.[7] A literature search was performed using PubMed from the National Library of Medicine.

The study design is illustrated in Figure 1.

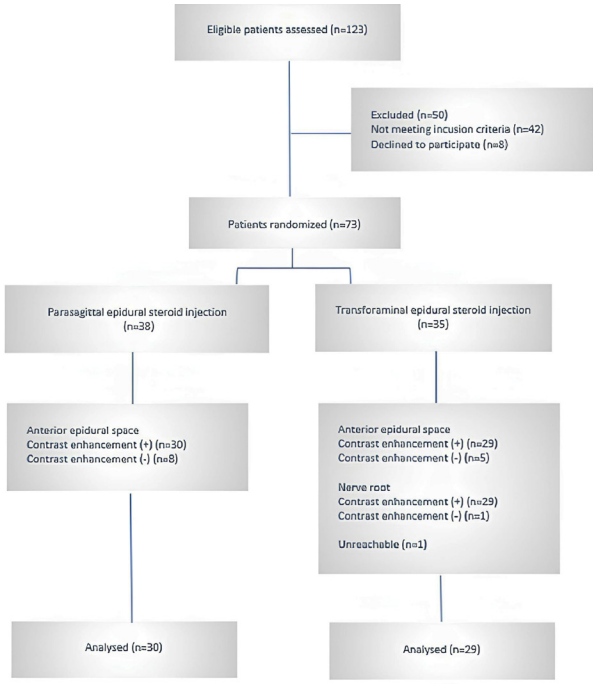

Figure 1. Flow chart diagram.

Intervention

Both procedures were performed under fluoroscopic guidance without sedation. To avoid dural puncture, needle distance was controlled in the lateral view using C-arm fluoroscopy. During the procedure, 4 mL of the contrast agent was administered. The number of vertebral levels spread by the contrast agent in the anterior epidural space was also recorded. As all participants had bi-level disc herniation, the procedure was performed at the clinically most prominent root level in the PS group, and at both root levels in the TF group.

Transforaminal Epidural Approach

A 22-gauge, 3.5-inch blunt-tip atraumatic needle was used. The L4-L5 and L5-S1 intervertebral foraminas were approached using the subpedicular (safe triangle) technique. We injected 2 mL of contrast medium at each level to determine epidural spread. We administered 4 mL of drug into each nerve root: two mL of dexamethasone 21-phosphate, one cc of 0.5% bupivacaine HCl, and one cc of saline.

Parasagittal Interlaminar Epidural Approach

An 18 gauge, 3.5 inc Tuohy needle was used. The entry point was approximately 1.5 cm lateral to the midline on

the side of the painful lower extremity in the L4-L5 or L5-S1 interlaminar space. Epidural space was obtained using a loss-of-resistance technique. After entering the epidural space, 4 mL contrast medium was administered. Spread into the anterior epidural space was observed and vertebral levels were noted. Four mL of dexamethasone 21-phosphate, two mL of 0.5% bupivacaine HCl and two cc of saline were injected, resulting in a total of eight mL of the drug. The contrast distribution is shown in Figure 2.

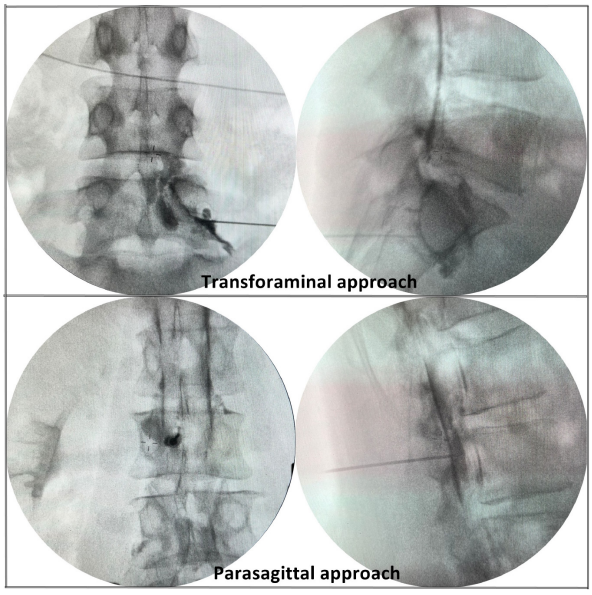

Figure 2. Upper left image: Anteroposterior view in transforaminal approach, Upper right image: Lateral view in transforaminal approach, Bottom left image: Anteroposterior view in parasagittal approach, Bottom right image: Lateral view in parasagittal approach.

Outcome Measures

VAS, Oswestry Disability Index (ODI), and comfort questionnaires were administered to all the patients. Total fluoroscopy time, extent of contrast spread into the anterior epidural space, and adverse events were recorded. The primary outcome measure was improvement in pain intensity. We asked the patients to report their VAS before and 2-4 weeks after treatment. Secondary outcomes were between-group differences in functionality improvement, fluoroscopy time, patient comfort, and side effects or complications. We assessed the improvement in functionality using the ODI score. The ODI is a patient-completed questionnaire that measures the functioning of patients with low back pain. The time at which the fluoroscopy device was active during the procedure was also recorded. We asked the patients to complete a comfort questionnaire after the procedure and to answer how they felt during the procedure using one of three options: comfortable, moderate, and uncomfortable. While answering this question, we asked them to rate the length of time they spent in the operating theatre and the pain they felt during and after the procedure. We monitored the patients for side effects during and after the procedure, and recorded their occurrence.

Statistical Analysis

All analyses were performed using Jamovi Project (2022, Jamovi version 2.3) (computer software). The results of this study are expressed as frequencies and percentages. Normality analysis was performed using the Shapiro-Wilk test, skewness kurtosis, and histograms. Normally distributed variables are presented as means and SDs. Categorical variables were compared using the chi-squared test. Independent samples t-tests and Mann-Whitney U tests were used to compare numerical dependent variables between the groups. Repeated measures were analyzed using Friedman's test with Bonferroni correction for multiple t-tests. Statistical significance was set at $P < 0.05$.

Results

Fifty-nine patients completed the third month of the follow-up. There was no difference in age or sex between the two groups ($P > 0.05$; independent samples t-test, chi-square test). We compared the VAS and ODI scores before and 2-4 weeks after the procedure (independent samples t-test, paired samples test, and Friedman test).

Fluoroscopy time and comfort scale scores were compared between the groups (independent samples t-test, Fisher's exact test, continuity correction, Pearson's chi-squared test, and Mann-Whitney U test) (Table 1).

There was no difference in the pre- and post-treatment VAS scores between the two groups (Table 1). When analyzed within each group, the decrease in the VAS scores over time was significant ($P < 0.001$ for both groups). When the change between time points was analyzed, the change between baseline two weeks and baseline four weeks was significant in both groups (Bonferroni correction; $P < 0.001$, both). There were no differences between the measurements at two and four weeks after treatment in either group (Table 2).

There was no difference in the ODI scores between the groups at baseline; a statistically significant decrease was observed in the PS group compared with the TF group in the second week (mean rank PS: 25.52, TF: 34.64, P=0.041) (Table 1). No differences were found between ODI measurements in the fourth week. When the change in ODI scores was analyzed over time, a significant decrease from baseline was observed in both groups ($P < 0.001$ for both). When the difference between time points was analyzed, the change in the ODI score between the basal 2 weeks and basal 4 weeks was significant in both groups (Bonferroni correction; $P < 0.001$ for both groups). There

was no significant difference between the two- and 4-week scores in either group (Table 2).

Total fluoroscopy time was 15.1±1.93 seconds in the PS group and 49.72±2.78 seconds in the TF group ($P < 0.001$). This duration was more than three times longer in the TF group than that in the PS group. According to the comfort query, 50% of the PS group replied comfortably, 40% moderately, and 10% uncomfortable. In the TF group, 51.7% of participants reported discomfort, 34.4% reported

Table 1. Demographic Data and Group Comparison

	Group PS	Group TF	Levene			
	n = 30	n = 29			Test st.	*P* value
			F	Sig.		
Age	53.37±10.41	52.17±10.3	0.016	0.899	0.443	0.660[a]
Gender						
Female (%)	22 (59.4)	15 (40.5)			2.093	0.148[b]
Male (%)	8 (36.3)	14 (63.6)				
ODI basal	68.5 (26-87) 63.80±17.73	77 (40-95) 73.14±13.21	2.797	0.1	-2.287	0.260[a]
ODI 2 week	20 (10-86) 25.13±16.67	26 (10-88) 36.34±22.69			569.5	**0.041[c]**
ODI 4 week	20 (10-87) 28.57±22.10	20 (10-80) 30.28±22.28			450	0.820[c]
VAS basal	6.5 (3-8) 6.4±1.32	7 (4-9) 7±1.25			-1.719	0.086[c]
VAS 2 week	2 (1-8) 2.3±1.95	2 (1-8) 2.76±2.11			-0.851	0.395[c]
VAS 4 week	2 (1-9) 2.63±2.20	2 (1-8) 2.83±2.13			-0.584	0.559[c]
Fluoroscopy time (sec)	15.1±1.93	49.72 ±2.78	2.133	0.15	-55.554	**<0.001[a]**
Contrast spread	n = 13, Level: 2 n = 15, Level: 3 n = 2, Level: 4	n = 25, Level 2 n = 4, Level 1				
Comfort query:						
Discomfort	3 (16.7%)[a*]	15 (83.3%)[b*]			14.537	**<0.001[d]**
Intermediate	12 (54.5%)[a*]	10 (45.5%)[a*]				
Comfortable	15 (78.9%)[a*]	4 (21.1%)[b*]				

[a], Independent samples t-test; [b], Continuity correction; [c], Mann-Whitney U test; [d], Pearson chi-square; [a*-b*], Differences in comfort query. Mean ± Standard deviation, Median (minimum-maximum).
PS, parasagittal; TF, transforaminal, ODI, oswestry disability index; VAS, visual analog scale.

Table 2. ODI and VAS Scores Over Time

		ODI			VAS		
		Median (min.-max.)/mean rank	Test st.	*P**value	Median (min.-max.)/mean rank	Test st.	*P**value
PS group	Basal	68.5 (26-87)/2.92	46.907	<0.001	6.5 (3-8)/2.9	48.326	<0.001
	2 week	20 (10-86)/1.58			2 (1-8)/1.45		
	4 week	20 (10-87)/1.50			2 (1-9)/1.65		
TF group	Basal	77 (40-95)/2.71	26.66	<0.001	7 (4-9)/2.83	43.3	<0.001
	2 week	26 (10-88)/1.79			2 (1-8)/1.55		
	4 week	20 (10-80)/1.50			2 (1-8)/1.62		

*Friedman test; PS, parasagittal; TF, transforaminal; ODI, Oswestry Disability Index; VAS, visual analog scale; min.-max., minimum-maximum.

moderate discomfort, and 13.7% felt comfortable. This difference was statistically significant ($P < 0.001$). We recorded the number of levels of contrast medium that had spread into the anterior epidural space. In the PS group, 57% of the patients had three or more levels of contrast spread, whereas in the TF group, we did not record three levels of contrast enhancement (Table 1).

No adverse events were observed in the PS group. Three complications occurred in the TF group: one case of disc penetration, one case of vascular penetration, and one patient who experienced transient paralysis for five hours (Figure 3). In the cases of intravascular injection and disc penetration, the procedure was successfully performed by changing the needle position and achieving the desired contrast distribution. The patient with transient paralysis was discharged 24 h after observation. At week 2, four patients in the TF group had increased pain compared to baseline, but by week 4, their pain was relieved.

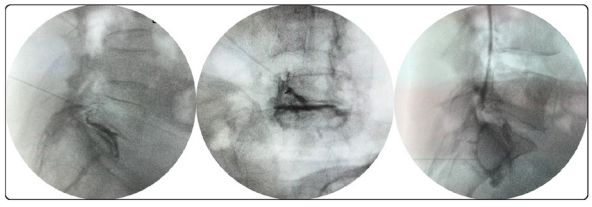

Figure 3. The left and middle images: Contrast enhancement of disc penetration, The right image: Vascular penetration.

Discussion

This study showed that PS and TF epidural steroid injections were successful in treating radicular low back pain due to L4-5 and L5-S1 posterolateral disc herniations. At the end of the first month, both treatments resulted in a 60% reduction in pain intensity and 50% improvement in function. According to our results, the VAS and ODI scores at week 4 were similar in both the groups. However, the ODI score was significantly lower in the PS group at week 2 (P=0.041). In the literature, the efficacy of TF ESI and PS epidural approaches has generally been found to be similar.[6,9-11] However, in a meta-analysis comparing the two methods, the PS approach was found to be superior for pain relief, but no difference was found in terms of functionality.[18] In the results of studies comparing midline, PS and TF approaches are conflicting.[6,19,20]

Epidural steroid injections are the cornerstone of treatment of low back pain caused by herniated discs or spinal stenosis. Injection into the epidural space began in the 1950s, using a caudal approach. Since the 1990s, interlaminar and transforaminal approaches have been used.[8] However, there is no consensus on which method is preferable.

Epidural approaches have been compared in patients with discogenic radicular low back pain but not in a homogeneous population. In previous studies, the level of disc herniation differed between patient groups. In this study, we evaluated the most common posterolateral protruded and extruded discopathy at the L4-L5 and L5-S1 levels, which had the highest incidence of herniation.[21]

The TF and PS approaches have become popular because of their easier access to the anterior epidural space. Anterior epidural contrast distribution is higher with PS and TF than with midline interlaminar administration,[22] but there is no consensus on the superiority of these techniques.[4,6,7,11,20,23] In our study, all patients in the PS group had at least two levels of contrast enhancement in the anterior epidural space, and 57% had three or more levels of contrast enhancement. In the TF group, the contrast remained at the levels we provided, and we did not observe three levels of contrast enhancement in any patient. Given this situation, the wide distribution achieved with a single injection in the PS approach is remarkable.

In our study, fluoroscopy time was much shorter in the PS group. This result was not surprising for this method, which was easier to perform. In contrast, the patient and pain practitioner were exposed to three times more radiation during the TF approach. Previous authors also reported a shorter fluoroscopy time with the PS method compared to the TF method.[20,23] However, in an article comparing the midline, PS and TF methods, this time was found to be similar for all three methods.[6]

We observed three complications in the TF group: disc penetration, vessel penetration, and transient paralysis. The absence of complications and low radiation exposure due to the shorter fluoroscopy time made the PS method more reliable. Intravascular penetration, spinal cord infarction, paraplegia, permanent paralysis and discitis have been reported with TF epidural steroid injections.[12-15,18]

To the best of our knowledge, these two methods have not been evaluated in terms of patient comfort. According to the comfort questionnaire, patient satisfaction was four times higher in the PS group than in the TF group.

Study Limitations

The short follow-up period is the main limitation of this study. In addition, we did not evaluate the analgesics used. However, comparing these two methods in patients with isolated L5 and S1 radiculopathy was an advantage of our study. Therefore, more reliable data were obtained.

Conclusion

In the treatment of L4-L5 and L5-S1 radiculopathy, the PS epidural approach produced a significantly greater improvement in the ODI scores at two weeks and was at least as effective as TF in reducing pain and improving function. Low adverse events and radiation exposure, improved patient comfort, and wide contrast distribution with a single-level procedure make the PS epidural approach preferable.

Ethics

Ethics Committee Approval: Ethics Committee approval was obtained from the University of Health Sciences Turkey, Dışkapı Yıldırım Beyazıt Training and Research Hospital Ethics Committee, and we are affiliated with and registered in Clinical Research (date: 07.03.2022, approval no: 132/10, Clinical Trial Number: NCT05551676).

Informed Consent: This was a prospective, randomized, controlled clinical trial.

Peer-review: Externally peer-reviewed.

Author Contributions: Surgical and Medical Practices - G.R.G.P., Ö.T.A., D.Y.; Concept - G.R.G.P., Ö.T.A., D.Y.; Design - G.R.G.P., G.Y., D.Y.; Data Collection or Processing - G.Y., Ö.T.A., E.C.; Analysis or Interpretation - Ö.T.A., E.C.; Literature Search - Ö.T.A., D.Y.; Writing - G.Y., D.Y.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Wheeler, AH, Murrey, DB. Chronic lumbar spine and radicular pain: Pathophysiology and treatment. *Curr Pain Headache Rep.* 2002;6(2):97-105. [CrossRef]
2. Carassiti M, Pascarella G, Strumia A, et al. Epidural steroid injections for low back pain: a narrative review. *Int J Environ Res Public Health.* 2022;19(1):231. [CrossRef]
3. Van Boxem K, Rijsdijk M, Hans G, et al. Safe Use of Epidural Corticosteroid Injections: Recommendations of the WIP Benelux Work Group. *Pain Pract.* 2019;19(1):61-92. [CrossRef]
4. Lundin A, Magnuson A, Axelsson K, Nilsson O, Samuelsson L. Corticosteroids peroperatively diminishes damage to the c-fibers in microscopic lumbar disc surgery. *Spine.* 2005;30:2362-2367. [CrossRef]
5. Kamble PC, Sharma A, Singh V, Natraj B, Devani D, Khapane V. Outcome of single level disc prolapse treated with transforaminal steroid versus epidural steroid versus caudal steroids. *Eur Spine J.* 2016;25(1):217-221. Epub 2015 May 12. [CrossRef]
6. Makkar JK, Gourav KKP, Jain K, et al. Transforaminal versus lateral parasagittal versus midline interlaminar lumbar epidural steroid injection for management of unilateral radicular lumbar pain: a randomized double-blind trial. *Pain Physician.* 2019;22(6):561-573. [CrossRef]
7. Kaur S, Gupta R, Singh S, Kumar R, Singh K. Impact of different approaches of epidural steroid injection on outcome of patients treated for low backache. *Anesth Essays Res.* 2017;11(3):697-701. [CrossRef]
8. Helm Ii S, Harmon PC, Noe C, et al. Transforaminal epidural steroid injections: a systematic review and meta-analysis of efficacy and safety. *Pain Physician.* 2021;24(S1):S209-S232. [CrossRef]
9. Ackerman WE 3rd, Ahmad M. The efficacy of lumbar epidural steroid injections in patients with lumbar disc herniations. *Anesth Analg.* 2007;104(5):1217-1222. [CrossRef]
10. Ghai KD, Katz JA, Chinthagada M, McCarthy RA, Knezevic NN. Incidence of intradiscal injection during lumbar fluoroscopically guided transforaminal and interlaminar epidural steroid injections. *Anesth Analg.* 2010;110(5):1464-1467. [CrossRef]
11. Hong JH, Park EK, Park KB, Park JH, Jung SW. Comparison of clinical efficacy in epidural steroid injections through transforaminal or parasagittal approaches. *Korean J Pain.* 2017;30(3):220-228. [CrossRef]
12. Goodman BS, Bayazitoglu M, Mallempati S, Noble BR, Geffen JF. Dural puncture and subdural injection: a complication of lumbar transforaminal epidural injections. *Pain Physician.* 2007;10(5):697-705. [CrossRef]
13. Smuck M, Fuller BJ, Yoder B, Huerta J. Incidence of simultaneous epidural and vascular injection during lumbosacral transforaminal epidural injections. *Spine J.* 2007;7(1):79-82. [CrossRef]
14. Furman MB, O'Brien EM, Zgleszewski TM. Incidence of intravascular penetration in transforaminal lumbosacral epidural steroid injections. *Spine (Phila Pa 1976).* 2000;25(20):2628-2632. [CrossRef]
15. Cohen SP, Maine DN, Shockey SM, Kudchadkar S, Griffith S. Inadvertent disk injection during transforaminal epidural steroid injection: steps for prevention and management. *Pain Med.* 2008;9(6):688-694. [CrossRef]
16. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behav Res Methods.* 2009;41(4):1149-1160. [CrossRef]
17. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods.* 2007;39(2):175-191. [CrossRef]
18. Knezevic NN, Paredes S, Cantillo S, Hamid A, Candido KD. Parasagittal Approach of Epidural Steroid Injection as a Treatment for Chronic Low Back Pain: A Systematic Review and Meta-Analysis. *Front Pain Res (Lausanne).* 2021;2:676730. [CrossRef]
19. Gupta R, Singh S, Kaur S, Singh K, Aujla K. Correlation between epidurographic contrast flow patterns and clinical effectiveness in chronic lumbar discogenic radicular pain treated with epidural steroid injections via different approaches. *Korean J Pain.* 2014;27(4):353-359. [CrossRef]
20. Ghai B, Bansal D, Kay JP, Vadaje KS, Wig J. Transforaminal versus parasagittal interlaminar epidural steroid injection in low back pain with radicular pain: a randomized, double-blind, active-control trial. *Pain Physician.* 2014;17(4):277-290. [CrossRef]
21. Al Qaraghli MI, De Jesus O. Lumbar Disc Herniation. [Updated 2023 Aug 23]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560878/. [CrossRef]
22. Weil L, Frauwirth NH, Amirdelfan K, Grant D, Rosenberg JA. Fluoroscopic analysis of lumbar epidural contrast spread after lumbar interlaminar injection. *Arch Phys Med Rehabil.* 2008;89(3):413-416. [CrossRef]
23. Candido KD, Raghavendra MS, Chinthagada M, Badiee S, Trepashko DW. A prospective evaluation of iodinated contrast flow patterns with fluoroscopically guided lumbar epidural steroid injections: the lateral parasagittal interlaminar epidural approach versus the transforaminal epidural approach. *Anesth Analg* 2008;106(2):638-644. [CrossRef]

DOI: 10.4274/TJAR.2023.231472

Case Report
Regional Anaesthesia

Turkish Journal of Anaesthesiology & Reanimation

Turk J Anaesthesiol Reanim 2023;51(6):510-512

Multiple Thoracic Wall Blocks for Awake Breast Surgery: A Case Report

Yavuz Gürkan, İlayda Kalyoncu, Doğa Şimşek, Mete Manici

Koç University Faculty of Medicine, Koç University Hospital, Department of Anaesthesiology and Reanimation, İstanbul, Turkey

Cite this article as: Gürkan Y, Kalyoncu İ, Şimşek D, Manici M. Multiple Thoracic Wall Blocks for Awake Breast Surgery: A Case Report. *Turk J Anaesthesiol Reanim.* 2023;51(6):510-512.

Abstract

Awake breast surgeries under nerve blocks have been a challenge for anaesthesiologists, and different block combinations have been used for surgery under sedation. Thoracic paravertebral block (TPVB) was thought to be sufficient alone for surgical anaesthesia of the breast. We performed a combination of TPVB, pectoralis nerve I block, and serratus anterior plane block for awake breast surgery in an elderly patient with serious comorbidities. Surgical anaesthesia was achieved, excluding skin incision. Any regional anaesthesia technique alone is not sufficient; rather, multiple thoracic wall blocks are needed for surgical anaesthesia of the breast.

Keywords: Awake surgery, breast surgery, PECS block, serratus anterior plane block, thoracic paravertebral block

Main Points

- It was thought that thoracic paravertebral block (TPVB) alone was sufficient for surgical anaesthesia of the breast.
- We performed a combination of TPVB, pectoralis nerve I block and serratus anterior plane block for segmental mastectomy.
- Surgical anaesthesia was achieved excluding skin incision.
- Multiple thoracic wall blocks are needed for surgical anaesthesia of the breast.

Introduction

Oncologic breast surgeries are mostly performed under general anaesthesia. However, elderly patients with serious comorbidities may not be well suited for general anaesthesia. Awake breast surgeries under nerve blocks have been a challenge for anaesthesiologists, and different block combinations have been used for surgery under sedation.[1] Among them, thoracic paravertebral block (TPVB) has been the most studied.[2] In this case report, after obtaining written informed consent for publication, we would like to share our experience regarding awake breast surgery under nerve blocks. This manuscript adhere to the case reports [CARE guidelines (for CAse REports)] statement.

Case Description

An 85-year-old female (height 150 cm, weight 72 kg, American Society of Anesthesiologists Physical Status III) with a history of hypertension, atrial fibrillation, congestive heart failure, coronary artery disease, and pulmonary hypertension was scheduled for segmental mastectomy due to a mass in the upper outer quadrant of the left breast. Segmental mastectomy was planned under regional anaesthesia using ultrasound-guided TPVB with serratus anterior plane and pectoral nerve blocks. Following premedication with 1 mg of intravenous midazolam,

Corresponding author: Doğa Şimşek, e-mail: dosimsek@ku.edu.tr

Received: November 10, 2023 Accepted: November 22, 2023

standard monitors (SpO_2, electrocardiography, non-invasive blood pressure) were applied, and the patient received 4 L of oxygen per minute via a face mask. TPVB was performed in the prone position in the operating room. Before block performance, 25 µg of intravenous (IV) fentanyl was administered. After skin preparation with 10% povidone-iodine, a linear ultrasound probe of GE Logiq P9 (Gyeonggi-do, Republic of Korea) was placed parallel to the vertebral spine at the T4 level and shifted 2-3 cm laterally to obtain the appropriate visualization. Following the identification of the pleura, transverse process, and paravertebral space, a 22 G 50 mm needle (BBraun ultra-360, Melsungen, Germany) was inserted caudal to the cranial direction using an in-plane approach. After confirming the position of the needle tip and observing tenting of the pleura with 1 mL of local anaesthetic (LA), 20 mL of LA mixture consisting of 7 mL of 0.5% bupivacaine, 5 mL of 2% lidocaine, 8 mL of isotonic sodium chloride was administered for the blocks at the T2 and T4 levels.

In the supine position, pectoralis nerve block was performed using 10 mL of the same LA mixture. The probe was placed medially to the coracoid process in the transverse position underneath the clavicle. The third rib, thoracoacromial artery, and pectoralis major and minor muscles were identified. The needle was inserted using an in-plane approach, and LA mixture was administered into the fascia between the pectoralis major and minor muscles.

A serratus anterior plane block was performed at the level of the fifth rib at the mid-axillary level. The probe was moved inferiorly down to the fifth rib. The serratus anterior muscles were visualized. Finally, the needle was inserted using an in-plane approach and advanced caudal to cranial direction until the needle tip was beneath the serratus muscles. Subsequently, 10 mL of the same LA mixture was injected under the fascia of the serratus muscles. Surgery started 30 min after block performance. Fentanyl 50 µg and propofol 10 mg IV were administered immediately before surgery. The patient felt pain only during the skin incision. Wound infiltration with 10 mL of 0.25% prilocaine was provided by the surgical team. Supplementary doses of propofol (total 70 mg) were administered to achieve sedation during surgery. At the end of surgery, paracetamol (1 g IV) was administered for postoperative analgesia. Surgery lasting 55 min was completed uneventfully. On follow-up, the patient reported a pain score of 4 on the numeric rating scale 1 h after surgery. Tramadol 50 mg IV was administered. The patient was discharged the next day without complications and was completely satisfied with the course of treatment.

Discussion

The risks of general anaesthesia in elderly patients with serious comorbidities are sufficiently high to conclude that there is a need for alternative techniques for surgical anaesthesia. To provide surgical anaesthesia for breast surgery, the clinician must first consider the breast and the superficial tissue innervated by the cutaneous branches of the intercostal nerves through T2-T6 levels. Second, deep layers such as the pectoralis major muscle and its fascia innervated by lateral and medial pectoral nerves, serratus anterior muscle, and latissimus dorsi muscle innervated by long thoracic nerve and thoracodorsal nerve should be taken into account.[2,3] Our combination of TPVB at two levels (T2-T4), PECS I, and serratus anterior plane blocks should have been adequate for surgical anaesthesia in segmental mastectomy. Although the patient did not feel any pain during deeper dissections, infiltration anaesthesia with 10 mL of 0.25% prilocaine was required for the skin incision. This may be due to the relatively dilute LA concentration we administered. The purpose of our dilute LA choice was to avoid potential LA toxicity due to multiple nerve blocks and infiltration anaesthesia.

It was thought that TPVB would be sufficient for surgical anaesthesia of breast surgery if adequate sedation was provided.[4] Pangthipampai et al.[5] reported that even multiple-level TPVB was not adequate to provide surgical anaesthesia. Unfortunately, the depth of sedation is highly variable, ranging from inadequate sedation to almost deep enough to resemble general anaesthesia without securing the airway with a laryngeal mask airway or tracheal intubation. Some authors still suggest that multiple-level TPVB block is all that is needed for most breast surgeries.[6] In our case, we observed that even in segmental mastectomy there is a need for additional interventions. It is essential to closely monitor the pain and sedation level of patients by both the anaesthesiologist and surgeon throughout the procedure.

Conclusion

Multiple thoracic wall blocks are required for surgical anaesthesia of the breast. Any regional anaesthesia technique is not sufficient when used alone for major breast surgery that involves dissection of the pectoralis major muscle and its fascia and possibly also the serratus anterior and latissimus dorsi muscles. Even when using multiple blocks covering all known nerves of the breast, infiltration anaesthesia by the surgeon might be required for skin incision. The search for the ideal block or block combinations for surgical anaesthesia of the breast continues.

Informed Consent: Written informed consent was obtained.

Peer-review: Externally peer-reviewed.

Author Contributions: Surgical and Medical Practices - Y.G., İ.K., D.Ş., M.M.; Concept - Y.G., D.Ş., M.M.; Design - Y.G., D.Ş., M.M.; Data Collection or Processing - Y.G., İ.K., D.Ş., M.M.; Analysis or Interpretation - Y.G., D.Ş., M.M.; Literature Search - Y.G., İ.K., D.Ş.; Writing - Y.G., İ.K., D.Ş.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1. Guay Md J. Breast surgery without general anesthesia: is paravertebral blockade sufficient? *Reg Anesth Pain Med*. 2021;46(5):460. [CrossRef]
2. Guay J, Grabs D. A cadaver study to determine the minimum volume of methylene blue or black naphthol required to completely color the nerves relevant for anesthesia during breast surgery. *Clin Anat*. 2011;24(2):202-208. [CrossRef]
3. Chin KJ, Versyck B, Pawa A. Ultrasound-guided fascial plane blocks of the chest wall: a state-of-the-art review. *Anaesthesia*. 2021;76(Suppl 1):110-126. [CrossRef]
4. Klein SM, Bergh A, Steele SM, Georgiade GS, Greengrass RA. Thoracic paravertebral block for breast surgery. *Anesth Analg*. 2000;90(6):1402-1405. [CrossRef]
5. Pangthipampai P, Karmakar MK, Songthamwat B, Pakpirom J, Samy W. Ultrasound-guided multilevel thoracic paravertebral block and its efficacy for surgical anesthesia during primary breast cancer surgery. *J Pain Res*. 2020;13:1713-1723. [CrossRef]
6. Hamilton DL, Pawa A. Anaesthesia for awake breast surgery. *BJA Educ*. 2022;22(12):452-455. [CrossRef]

2023 Referee Index

Ahmet Kemalettin Koltka
Ali Ahıskalıoğlu
Alparslan Apan
Alparslan Kuş
Alper Tunga Doğan
Asli Z Demir
Ayşe Ciğdem Tütüncü
Aysun Ankay Yılbaş
Azize Beştaş
Bahadır Çiftçi
Bahar Kuvaki
Bahattin Tuncalı
Banu Kılıçaslan
Beliz Bilgili
Berrin Günaydın
Berrin Işık
Bora Bilal
Bülent Serhan Yurtlu
Burhan Dost
Can Aksu
Canan Balcı
Canan Bor
Cengiz Mordeniz
Ceyda Özhan Çaparlar
Çimen Gülben Olguner
Deniz Karakaya
Didem Tuba Akçalı
Dilek Erdoğan Arı
Ebru Biricik
Elvan Öçmen
Emre Erbabacan
Ender Gedik
Eren Fatma Akçıl
Erkan Tomatır
Esra Çalışkan
Eyyüp Sabri Özden
Fatma Ezgi Can
Fatma Nur Kaya
Ferruh Ayoğlu
Filiz Alkaya Solmaz
Fuat H. Saner
Gaye Aydın
Gözde İnan
Gülay Ok
Güldem Turan
Gülsen Keskin
Gülser Çalışkan
Güven Özkaya
Hale Aksu Erdost
Hale Kefeli Çelik
Halil Çetingök
Hande Gürbüz
Hasan Kutluk Pampal
Hija Yazıcıoğlu
Hilal Ayoğlu
Hülya Başar
Hülya Ulusoy
Hüseyin İlksen Toprak
İsmail Demirel
Jülide Ergil Hallıoğlu
Kerem Erkalp
Kubilay Demirağ
Kübra Evren Şahin
Mehmet Büget
Mehmet Özgür Özhan
Mehmet Turan İnal
Menşure Kaya
Murat Aksun
Murat Haliloğlu
Murat Şahin
Murat Sayın
Musa Zengin
Mustafa Arslan
Mustafa Azizoğlu
Naci Murat
Nadide Aysun Postacı
Nedim Çekmen
Nermin Kelebek Girgin
Nesil Coşkunfırat
Nevriye Salman
Nezih Sertöz
Nimet Şenoğlu
Nüzhet Mert Şentürk
Ömer Taylan Akkaya
Onat Bermede
Onur Balaban
Onur Özlü
Onur Selvi
Oya Yalçın Çok
Özge Köner
Özgür Canbay
Özlem Sağır
Özlem Selvi Can
Pakize Kırdemir
Pembe Keskinoğlu
Perihan Ekmekçi
Pınar Günel
Recai Dağlı
Recep Aksu
Şebnem Rumeli
Selin Erel
Serkan Tulgar
Sevim Cesur
Sezgin Ulukaya
Şükran Geze Saatçi
Şule Özbilgin
Suna Akın Takmaz
Ünase Büyükkoçak
Yavuz Gürkan
Yunus Gürkan Türker
Yusuf Tunalı
Zehra İpek Arslan
Zekeriyya Alanoğlu
Zeynep Çağıran
Zeynep Nur Akçaboy
Züleyha Kazak Bengisun

2023 Author Index

2023 Author Index

2023 Author Index

2023 Author Index

2023 Subject Index

2023 Subject Index

2023 Subject Index