

# Locoregional anesthesia in Enhanced Recovery After Surgery (ERAS) for reconstructive breast surgery: A narrative review

T. BRAECKMANS<sup>1</sup>, V. SALDIEN<sup>1</sup>

<sup>1</sup>Faculty of Medicine and Health Science, Department of Anaesthesiology, Antwerp University Hospital, University of Antwerp, Antwerp, Belgium.

Corresponding author: Dr. Braeckmans T., Drie Eikenstraat 655, 2650 Edegem, Belgium.  
Email : Thomas.braeckmans@uza.be

## Abstract

This review attempts to provide a comprehensive evaluation of ERAS protocols applied to deep inferior epigastric perforator (DIEP) flap breast reconstructions. The focus is the integration of ERAS with locoregional anesthesia techniques to enhance patient outcomes, reduce opioid usage, and reduce length of stay. Employing a methodical literature review conducted through PubMed, the study synthesizes findings from articles that meet specific inclusion criteria to explore the effectiveness of ERAS in the specific context of breast reconstruction. The thesis is structured to guide the reader through the various phases of ERAS illustrating how each phase contributes to optimizing patient recovery. Special attention is given to locoregional anesthesia techniques such as transversus abdominis plane blocks and paravertebral blocks, and their role in reducing postoperative pain and opioid reliance. The discussion emphasizes the economic implications of shorter hospital stays and decreased opioid consumption, presenting ERAS not only as a clinical success but also as a cost-effective strategy. Therefore, the authors advocate for a wider adoption of ERAS protocols in reconstructive breast surgery, suggesting that further research could refine these strategies to maximize their benefits.

**Keywords:** Enhanced Recovery After Surgery, Mammoplasty, Length of stay, Nerve block.

## Introduction

Enhanced recovery after surgery (ERAS) represents a significant paradigm shift in postoperative care, emphasizing a multimodal, interdisciplinary approach that has been widely adopted across various surgical specialties. Originally developed for colorectal surgery, ERAS protocols have demonstrated remarkable success in reducing length of stay (LOS) and inpatient narcotic use, without compromising morbidity outcomes. At the heart of ERAS is the goal to facilitate early recovery after major surgeries through a series of preoperative, intraoperative, and postoperative strategies<sup>1,2</sup>.

Deep inferior epigastric perforator (DIEP) flap surgery, a cornerstone in reconstructive breast surgery, is a type of surgery perfectly fit for ERAS. These techniques offer outcomes that closely mimic natural breast tissue with minimal donor site morbidity, aligning perfectly with ERAS goals to enhance patient outcomes, reduce hospital stays,

and minimize complications. The implementation of locoregional anesthesia techniques within ERAS protocols for DIEP flap surgery is especially noteworthy, reducing reliance on systemic opioids, diminishing postoperative pain, and facilitating earlier mobilization<sup>3</sup>.

## Methods

The objective of this narrative review was to examine the application, efficacy, and outcomes of ERAS protocols specifically for DIEP flap breast reconstruction with a focus on locoregional anesthesia. To achieve a comprehensive overview of the subject matter, we devised a focused search strategy that would enable us to gather the most relevant and informative literature on the topic.

Our literature search was conducted exclusively on PubMed, a widely recognized database for medical and surgical research literature. The search strategy utilized a combination of key terms and phrases to encompass a broad spectrum of

studies related to our topic of interest. The search terms used were as follows: breast surgery OR breast reconstruction OR DIEP OR Deep Inferior Epigastric Artery AND ERAS OR enhanced recovery after surgery. This combination was selected to ensure the inclusion of articles that specifically discuss ERAS protocols in the context of breast surgeries and DIEP flap reconstructions. The initial search yielded a total of 244 articles. To refine this list and ensure the relevance of the articles to our narrative review, titles and abstracts were screened, resulting in 87 articles deemed potentially relevant for further examination. The summary of the selection process is displayed as a PRISMA flowchart, in Figure 1.

The selection process for inclusion in the review involved a detailed assessment of these 87 articles by two independent reviewers. This assessment focused on the relevance of each article to the implementation and impact of ERAS protocols in breast surgery settings. During this phase, a book relevant to our review topic was also identified and included due to its comprehensive coverage of ERAS protocols, providing valuable insights beyond the scope of journal articles alone.

Articles and the identified bookchapters were evaluated based on their contribution to understanding ERAS protocols' roles, challenges, and benefits in breast surgery and DIEP flap procedures. Disagreements between reviewers were resolved through discussion.

## Findings

### Principles ERAS

ERAS protocols are structured into five systematic phases aimed at optimizing patient outcomes from preadmission through postdischarge. The first phase prepares patients with detailed counseling and lifestyle modifications like smoking cessation and weight reduction to reduce surgical risks. Preoperative planning constitutes the second phase, involving precise diagnostic imaging and dietary preparations to ready the patient metabolically. The third phase focuses on perioperative measures to prevent complications, incorporating strategies such as venous thromboembolism prophylaxis, antimicrobial measures, and multimodal analgesia including locoregional anesthesia. Postoperatively, the fourth phase shifts focus to pain management, nutritional support, and wound care, employing opioid-sparing strategies to facilitate early recovery. Finally, the fifth phase extends recovery beyond hospitalization, emphasizing home-based support and rehabilitation to ensure a smooth transition to daily activities while supporting the patient's psychological well-being. Together, these phases streamline the recovery process, minimize complications, and promote a swift return to normalcy.

### Benefits of ERAS

ERAS protocols offer a transformative approach to perioperative care, uniting evidence-based,

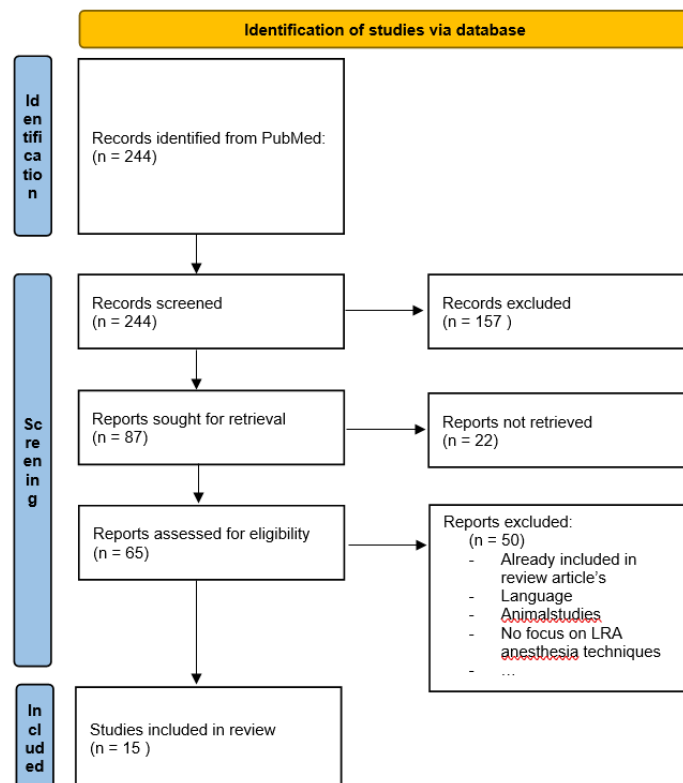


Fig. 1 — PRISMA Flowchart.

multimodal strategies to significantly improve patient outcomes. By reducing hospital stays and optimizing pain management with less reliance on opioids, ERAS facilitates a quicker return to normalcy for patients, contributing to higher satisfaction levels and enhanced recovery experiences. The protocols also reduce complication rates, fostering safer patient care environments. A key aspect of ERAS is its multidisciplinary approach, which enhances team communication and patient care coordination, leading to more efficient and cost-effective healthcare delivery. This comprehensive strategy not only boosts patient well-being post-surgery but also aligns healthcare practices with the goals of improved safety, reduced readmissions, and overall healthcare sustainability.

#### *Reduction in Length of Stay (LOS)*

The adoption of ERAS protocols in deep inferior epigastric perforator (DIEP) flap surgery has led to a significant reduction in hospital LOS. In a study of Offodile et al., they analyzed eight studies involving 1,151 patients, showing a consistent decrease in LOS by 1.58 days, a clinically and statistically significant effect, which improved further to 1.78 days after refining the data to eliminate double counting<sup>4</sup>.

In a study by Araya et al. involving 121 patients who underwent DIEP free-flap breast reconstruction, the adoption of ERAS protocols led to a significant reduction in the hospital LOS by an average of 0.98 days (SD, 0.17; confidence interval [CI], -1.3 to -0.64;  $P < 0.001$ ), when comparing periods before and after ERAS implementation<sup>5</sup>.

A systematic review and meta-analysis by Pierzchajlo et al., which included 14 studies with a total of 2102 patients, found that implementing ERAS protocols resulted in an average reduction of hospital stay by 1.12 days compared to traditional care approaches<sup>6</sup>.

The reduction in hospital LOS achieved through ERAS protocols signifies more than a mere numerical improvement. It marks a profound enhancement in patient care and surgical recovery. Beyond the immediate recovery benefits, this decrease in LOS also brings broader advantages, including heightened patient satisfaction, greater cost-effectiveness, and a diminished risk of hospital-acquired infections, thereby underlining the multifaceted value of ERAS<sup>1,4</sup>.

#### *Decreased opioid consumption*

The adoption of ERAS pathways has been instrumental in achieving significant reductions in Morphine Milligram Equivalent (MME)

usage among hospitalized patients reported as milligrams, with a conversion table for specific opioids. Analysis from five studies involving 623 patients revealed that ERAS protocols led to a mean reduction in total MME use of 183.96. This effect size demonstrates ERAS's robust impact on reducing opioid dependence despite the substantial heterogeneity observed across different types of reconstructive surgeries. A more focused analysis on free flap reconstructions under ERAS further highlighted an even larger decrease in MME, emphasizing the protocol's potent efficacy in pain management with reduced narcotic requirements<sup>1,4</sup>.

An other study by Ochoa et al. they looked at 409 patients, with 205 in the pre-ERAS group and 204 following the ERAS protocol showed a significant reduction. There were no significant differences ( $p > 0.05$ ) between the groups in terms of mean age, surgical side, timing of the reconstruction, or the number of prior abdominal surgeries. The average duration of surgery was comparable between the groups ( $450.1 \pm 92.7$  minutes for the pre-ERAS group vs.  $440.7 \pm 93.5$  minutes for the ERAS group), and the incidence of complications was similar ( $p > 0.05$ ). However, the mean intraoperative ( $58.9 \pm 32.5$  for pre-ERAS vs.  $31.7 \pm 23.4$  for ERAS) and postoperative ( $129.5 \pm 80.1$  for pre-ERAS vs.  $90 \pm 93.9$  for ERAS) MME usage showed significant reductions ( $p < 0.001$ ) in the ERAS group<sup>7</sup>.

In the same systematic review and meta-analysis as mentioned before by Pierzchajlo et al., findings revealed that the ERAS group experienced a considerable decrease in postoperative oral morphine equivalents (OME) by 104.02 OME, reported in milligrams (with a conversion table), highlighting the effectiveness of ERAS protocols in minimizing opioid dependency<sup>6</sup>.

Extending beyond inpatient care, the ERAS approach also significantly influenced MME usage in the outpatient setting, with the ERAS group experiencing a notable decrease in median total MME use compared to their pre-ERAS counterparts. This reduction was particularly pronounced in the initial weeks following discharge, underscoring ERAS's lasting effect on opioid stewardship without deteriorating pain control, as evidenced by comparable pain scores between the ERAS and pre-ERAS groups<sup>8</sup>.

#### *Economic benefits*

A reduced length of hospital stay indirectly influences financial aspects, thereby having significant economic implications. In the study conducted by Fracol et al., between April 2019 and December 2021, the introduction of an ERAS

protocol for autologous tissue breast reconstruction showcased significant advancements in patient care, emphasizing early hospital discharge within 24 to 48 hours. The implementation of this protocol effectively reduced the average hospital stay to approximately 1.97 days. While the protocol primarily aims to enhance patient recovery and care quality, the decreased length of hospital stay naturally has a substantial indirect economic impact. By facilitating earlier discharges, the demand for prolonged hospital resources diminishes, consequently lowering associated healthcare costs<sup>9</sup>.

In a study of Atamian et al. in 2023 they focused on assessing the impact of an ERAS protocol on hospital LOS and financial outcomes for patients undergoing Deep Inferior Epigastric Perforator (DIEP) flap breast reconstruction. The ERAS protocol introduced at a single institution involved comprehensive preoperative patient education, intraoperative care including locoregional anesthesia, and postoperative strategies to promote early recovery. A comparison between pre-ERAS and ERAS groups showed a significant reduction in hospital LOS and associated costs, highlighting the effectiveness of ERAS protocols in enhancing patient recovery while also presenting an opportunity for cost savings in healthcare<sup>10</sup>.

Moreover, the study revealed that the implementation of ERAS protocols could lead to a 7.5% decrease in overall direct costs, primarily through reductions in pharmacy, room and board, operating room labor, and provider costs. This reduction in costs, alongside the clinical benefits of decreased LOS and opioid use, underscores the potential of ERAS protocols to contribute to more efficient and cost-effective care in autologous breast reconstruction<sup>10</sup>.

Despite its retrospective nature and limitations regarding post-discharge outcomes, the study emphasizes the positive impact of ERAS protocols on both patient care and the financial aspects of healthcare delivery. However, one should keep in mind that LOS is not the only determining factor in economic benefit. Future research is encouraged to explore further advancements in ERAS protocols and their comprehensive cost implications, aiming to optimize patient outcomes while addressing the financial challenges of healthcare systems<sup>10</sup>.

### *Locoregional Anesthesia*

#### *Why to apply locoregional anesthesia techniques in DIEP Flap Surgery?*

Recent studies highlight a significant concern, noting that two-thirds of women undergoing breast cancer surgery may develop chronic pain.

The integration of regional anesthesia with general anesthesia has been shown to play a crucial role in managing acute postoperative pain, preventing its progression to chronic pain while also reducing opioid consumption. This approach minimizes opioid-related side effects such as nausea, vomiting and respiratory depression. The result is an acceleration in patient recovery, characterized by early mobilization, quicker return of bowel function, and shorter hospital stays, ultimately enhancing the overall care and recovery process in breast surgery, including DIEP flap procedures<sup>2,3,11-13</sup>.

In the specific context of DIEP flap surgery, the selection and application of locoregional anesthesia techniques are carefully tailored to maximize patient outcomes. While epidural anesthesia is less commonly used, paravertebral blocks emerge as a preferred choice for providing effective unilateral analgesia with minimal risk of hypotension. Techniques such as Transversus Abdominis Plane (TAP) blocks are increasingly favored for their direct action on abdominal wall pain without significant systemic effects. The strategic use of peripheral nerve blocks, extends pain relief well into the postoperative period, showcasing the adaptability and efficacy of locoregional anesthesia in improving patient recovery after DIEP flap surgery<sup>2,3,11,14,15</sup>.

#### *What types of locoregional anesthesia have been used?*

In DIEP flap surgery, locoregional anesthesia plays a crucial role in enhancing recovery and reducing opioid dependency, with several options available.

#### *Epidural anesthesia*

A retrospective review by Cormier et al. of DIEP free flap reconstructions revealed that patients who received epidural anesthesia (EA) in addition to general anesthesia (GA) showed a modest improvement in postoperative pain scores without a significant reduction in 48-hour narcotic usage, compared to those who underwent GA alone. Despite no differences in surgery duration or flap complication rates, the EA/GA group encountered operative delays, including a significantly delayed start of the operation, and higher intraoperative vasopressor consumption. This suggests that while epidural blocks offer pain management benefits, they may introduce challenges in surgical logistics and potentially increase the risk of complications related to vasopressor use<sup>16</sup>.

In a review by Yeung et al. that is not directly related to DIEP flap surgery but is mentioned to highlight alternatives to epidural anesthesia,

the effectiveness and complications of epidural anesthesia (EA) versus paravertebral block (PVB) were compared for managing pain after thoracotomy surgery. This analysis included 14 studies involving 698 participants. The findings indicate that both EA and PVB offer similar analgesic effects for post-thoracotomy pain, with no significant differences in 30-day mortality or major complications. However, PVB was associated with fewer minor complications such as hypotension, nausea, vomiting, pruritus, and urinary retention. Although DIEP flap surgery is not a thoracotomy, it often involves similar regional procedures, including rib cutting, making the comparison relevant<sup>17</sup>.

In an other comparative study on postoperative analgesia methods for patients undergoing deep inferior epigastric artery perforator flap-based breast reconstruction, the effectiveness of thoracic epidural anesthesia was evaluated against transversus abdominis plane (TAP) blocks with liposomal bupivacaine. Analyzing thirty patients, half of whom received thoracic epidural and the other half TAP blocks, the study aimed to assess opioid consumption, measured in oral OMEs, over the first three postoperative days, alongside the timing of Foley catheter removal and hospital discharge. Findings indicated no significant differences in opioid consumption on the first two days; however, by postoperative day 3, patients administered TAP blocks with liposomal bupivacaine showed significantly lower opioid use and benefitted from earlier Foley catheter removal and reduced hospital stay durations. Specifically, TAP block patients were discharged approximately 0.8 days earlier than those who received epidural anesthesia, underscoring the potential of TAP blocks with liposomal bupivacaine to enhance postoperative recovery and reduce opioid reliance in microvascular breast reconstruction surgery<sup>15</sup>.

In their systematic review and meta-analysis, Baeriswyl et al. evaluated the analgesic efficacy of the transverse abdominis plane (TAP) block versus epidural analgesia following abdominal surgery, incorporating ten controlled trials with 505 patients, guided by PRISMA protocols. The study primarily measured pain scores and secondary outcomes like hypotension rates, hospital stay lengths, and time to first bowel sound and flatus. Findings revealed no significant differences in pain relief between the two methods on the first postoperative day. Notably, the epidural group experienced more hypotension, whereas the TAP block group benefited from shorter hospital stays. This comparison underscores the similar effectiveness of both analgesic techniques,

though TAP blocks are associated with fewer complications and shorter hospitalizations. These insights are included to highlight relevant analgesic options for the substantial abdominal component of DIEP flap surgery, explaining the inclusion of such studies in the review<sup>18</sup>.

Further investigations into epidural pain management for DIEP flap reveal several limitations. Studies demonstrate methodological inconsistencies such as varying analgesic dosages, unclear randomization processes, and lack of long-term follow-up, which could influence the outcomes related to pain management, recovery, and complication rates. Moreover, the high cost of liposomal bupivacaine raises concerns about the cost-effectiveness. These findings emphasize the necessity for rigorous, well-constructed clinical trials aimed at establishing definitive recommendations for postoperative pain management. But given the limitations and challenges of epidural analgesia and the benefits of the alternative blocks, it may not be the preferred first-line option for pain management in DIEP flap surgeries, emphasizing the need to consider alternative analgesic strategies<sup>15-19</sup>.

#### Paravertebral Blocks

As said before paravertebral blockade matched thoracic epidural blockade in acute pain control for thoracotomy surgery and lowered minor complication risks, with no significant differences in 30-day mortality, major complications, or hospital stay durations<sup>17</sup>. It is safe to assume that a similar effect can be observed in DIEP flap surgeries.

In another study focusing on the use of preoperative paravertebral blocks (PVB) for enhancing postoperative recovery in patients undergoing autologous microvascular breast reconstruction, particularly deep inferior epigastric perforator (DIEP) flaps, significant improvements were observed in pain management and hospital stay reduction. The analysis, targeting a cohort of patients who received PVB in addition to general anesthesia compared to those who received general anesthesia alone, illuminated the potential of PVB to substantially enhance post-surgical outcomes for patients undergoing this specific type of breast reconstruction. The study's findings revealed that patients benefiting from PVB experienced significantly lower pain scores both 2 and 24 hours post-operation, showcased a faster transition to oral pain management, and enjoyed notably shorter hospital stays. This reduction in dependency on intravenous opioids and the accelerated discharge from hospital premises underscore the efficiency

of PVB in managing acute postoperative pain, an essential determinant of overall recovery and hospital resource utilization<sup>20</sup>.

In their 2018 systematic review, Offodile et al. meticulously examined 1227 articles, eventually including nine studies involving 936 women, to assess the impact of preoperative paravertebral blocks (PVB) on postoperative pain management in breast reconstruction surgeries, including both immediate and delayed procedures. Notably, two randomized controlled trials and seven retrospective cohort studies contributed to this analysis. The study primarily employed ultrasound guidance for the application of paravertebral blocks (PVB), using 0.5% bupivacaine or ropivacaine<sup>21</sup>.

Pain outcomes reported across these studies highlighted PVB's efficacy in significantly reducing pain scores in both autologous and prosthetic breast reconstructions at various postoperative intervals. Notably, the impact of PVB on postoperative nausea and vomiting (PONV) was explored, with mixed results across studies, however certain analyses suggested a potential benefit of PVB in reducing antiemetic use. LOS outcomes varied, with significant reductions noted in autologous reconstruction studies for PVB recipients, while prosthetic reconstruction studies presented inconsistent findings on LOS impact<sup>21</sup>.

Technical block failure rates were documented in two studies without any reported clinical complications from PVB, such as pneumothorax or local anesthetic toxicity. This comprehensive review underscores PVB's role in enhancing postoperative recovery in breast reconstruction surgeries, signifying its potential to alleviate pain, possibly reduce PONV, and in the case of DIEP flap surgery, shorten hospital stays<sup>21</sup>.

#### Transversus Abdominis Plane (TAP) Blocks

In the context of DIEP flap surgery, the Transversus Abdominis Plane (TAP) block presents an appealing option for postoperative pain management. By targeting the abdominal wall nerves, it offers comparable analgesic efficacy to traditional epidural analgesia, but with fewer side effects, such as hypotension, and potentially a shorter hospital stay. Its application in abdominal surgeries suggests it could be a viable alternative in DIEP flap procedures, as detailed earlier in the text<sup>18</sup>.

As previously mentioned, liposomal bupivacaine is one of the options for TAP block in breast reconstruction surgeries. However, recent studies have raised concerns about its use, highlighting limited benefits in opioid consumption reduction and pain management enhancement within ERAS

protocols. These studies, including a retrospective analysis and a double-blinded randomized controlled trial, have demonstrated that a local analgesic cocktails or plain bupivacaine in TAP blocks either outperform or match the postoperative pain management effectiveness of liposomal bupivacaine. These findings cast doubt on the effectiveness and cost-efficiency of liposomal bupivacaine<sup>15,22,23</sup>.

In a comprehensive systematic review and meta-analysis conducted by Chi et al. in 2020, the effectiveness of transversus abdominis plane (TAP) blocks in abdominally based microsurgical breast reconstruction was evaluated across 12 studies, involving a total of 1,107 patients. This investigation aimed to ascertain the clinical impact of TAP blocks on postoperative outcomes, specifically focusing on hospital LOS, opioid consumption, patient-reported pain scores, hospital costs, and postoperative complications. The analysis highlighted a significant reduction in hospital LOS by an average of 0.91 days ( $p < 0.00001$ ) and a decrease in total opioid use by 133.80 mg of oral morphine equivalents ( $p < 0.00001$ ) for patients who received TAP blocks. Notably, these benefits were observed without any statistically significant changes in patient-reported postoperative pain scores (mean difference: -0.07,  $p = 0.86$ ) or hospital costs. Moreover, the review found no significant difference in the rate of postoperative complications between patients who received TAP blocks and those who did not, indicating that the adoption of TAP blocks in ERAS protocols for breast reconstruction enhances patient outcomes without compromising safety. The study's findings underscore the value of incorporating TAP blocks into perioperative care strategies to improve recovery metrics in abdominally based microsurgical breast reconstruction, while also calling for further research to optimize pain management protocols and explore the differential benefits among various patient subpopulations<sup>24</sup>.

#### Rectus Sheath Blocks

The rectus sheath block, while effective for providing analgesia to the anterior abdominal wall, is not the optimal choice for managing pain in deep inferior epigastric perforator (DIEP) flap surgeries for breast reconstruction. This limitation primarily stems from anatomical considerations, as the procedure involves the transfer of skin, fat, and blood vessels from the lower abdomen to reconstruct the breast. The primary concern of the surgeon revolves around the potential risk of compromising the integrity of the perforator arteries, which are crucial for the vascularization

of the transferred tissue. This risk is a significant deterrent, as maintaining optimal blood flow to the DIEP flap is paramount for successful surgery and healing. Therefore, the preference leans towards alternative analgesic methods that assure safety for the flap's blood supply while effectively addressing the pain needs of the patient.

#### Other blocks

PECS blocks, Serratus Anterior Plane (SAP) blocks, and Erector Spinae Plane (ESP) blocks have significantly improved postoperative pain outcomes for initial breast cancer surgeries. These blocks, by targeting specific nerve distributions affected during mastectomies, lumpectomies, and axillary clearance, offer tailored analgesia while reducing the reliance on systemic opioids. However, when transitioning the discussion to DIEP flap surgeries for breast reconstruction, the direct applicability of these blocks diminishes. The distinct anatomical areas and types of pain encountered in DIEP flap reconstructions necessitate a more specialized approach to pain management. In the current literature, there is a noticeable scarcity of detailed information regarding the application of PECS blocks, Serratus Anterior Plane (SAP) blocks, and Erector Spinae Plane (ESP) blocks specifically for DIEP flap surgeries. The anatomical alterations following mastectomy present potential challenges in effectively utilizing some of these blocks.

#### Combination of different blocks

Studies by Guffey et al. and Abdelaziz Atwez et al. provide compelling evidence supporting the integration of specific regional blocks within ERAS protocols to optimize patient outcomes in breast reconstruction surgeries.

Guffey's study explores the evolution of pain management strategies in autologous breast reconstruction, highlighting the shift from traditional opioid-based methods to the implementation of ERAS protocols enriched with regional anesthesia. The introduction of a T3 paravertebral block marked a significant milestone, showing notable improvements in pain control, reduced opioid requirements, and shortened hospital stays. The study further elaborates on the comprehensive ERAS protocol adopted later, emphasizing multimodal analgesia, which includes both paravertebral and TAP blocks, aimed at covering all anatomical areas affected during reconstruction. This approach not only standardized care but also significantly enhanced postoperative recovery metrics, demonstrating the profound impact of combining regional blocks within an ERAS framework<sup>3</sup>.

Atwez et al. expand on this concept by examining the outcomes of implementing maximal locoregional nerve blocks targeting both the thoracic and abdominal regions as an integral component of ERAS protocols in breast reconstruction. Their retrospective study underscores the benefits of a more aggressive anesthetic strategy, which resulted in further reductions in hospital LOS and opioid consumption, along with minimal postoperative complications. The use of comprehensive locoregional blocks, including both TAP and thoracic paravertebral blocks, provided a superior pain management solution that contributed to enhanced patient recovery experiences and outcomes<sup>14</sup>.

Both studies collectively assert the significance of integrating advanced regional anesthesia techniques in ERAS protocols for autologous microvascular breast reconstruction. They illustrate how targeted pain management strategies, especially the combination of thoracic and abdominal nerve blocks, can profoundly influence the recovery trajectory by minimizing pain, reducing reliance on opioids, and shortening hospital stays. This evidence advocates for the adoption of such comprehensive ERAS protocols as the standard of care in breast reconstruction surgery, promising improved patient satisfaction and quality of life postoperatively<sup>3,14</sup>.

#### Discussion

The paradigm shift towards ERAS protocols, especially in reconstructive breast surgery like the Deep Inferior Epigastric Perforator (DIEP) flap surgery, underscores a multidisciplinary approach aimed at optimizing patient recovery. The integration of locoregional anesthesia within these protocols plays a pivotal role in diminishing the reliance on systemic opioids, thus streamlining the postoperative recovery process. This narrative review delves into the efficacy and economic implications of locoregional blocks, underscoring their value in ERAS protocols for DIEP flap surgery while contemplating future investigative directions and the economic implications of these practices.

Locoregional anesthesia, including paravertebral, Transversus Abdominis Plane (TAP) blocks, and potentially underexplored blocks like PECS, Serratus Anterior Plane (SAP), and Erector Spinae Plane (ESP) blocks, have demonstrated significant reductions in opioid consumption and length of hospital stay. These outcomes not only enhance patient satisfaction but also present a cost-effective solution by potentially lowering

hospital-associated costs and minimizing the risk of opioid-related side effects.

Despite these advancements, the high cost of certain anesthetic agents like liposomal bupivacaine poses economic challenges, raising questions about the cost-benefit ratio of such interventions within ERAS protocols. Further research is warranted to explore more cost-effective alternatives that do not compromise the quality of postoperative analgesia.

Moreover, the literature highlights a gap in the exploration of alternative blocks that could further refine pain management strategies in breast reconstruction surgery. Blocks such as PECS, SAP, and ESP, while beneficial in initial breast surgeries, lack comprehensive studies to ascertain their effectiveness in the specific context of DIEP flap surgeries. Investigating these alternatives could unveil novel analgesic strategies that align with the principles of ERAS, promoting faster recovery and reducing opioid dependency.

The economic relevance of incorporating locoregional anesthesia in ERAS protocols extends beyond immediate postoperative outcomes. By reducing hospital stay durations and opioid consumption, these protocols contribute to significant healthcare savings, advocating for their broader adoption. However, this economic benefit must be balanced with the initial costs of locoregional anesthetic agents, necessitating a nuanced understanding of long-term cost implications.

Furthermore, tailoring ERAS protocols to cater to specific patient subpopulations in DIEP flap surgery could enhance the precision and effectiveness of postoperative care. Understanding individual patient could optimize outcomes, patient satisfaction and length of hospital stay. This personalized approach, supported by robust clinical evidence, promises to refine ERAS protocols further, ensuring they meet the diverse needs of patients undergoing reconstructive breast surgery.

## Conclusion

The integration of locoregional anesthesia within ERAS protocols for Deep Inferior Epigastric Perforator (DIEP) flap breast reconstruction has markedly improved postoperative care, offering a promising approach that enhances patient recovery, diminishes the need for opioids, and proves to be economically beneficial. This advancement facilitates the possibility of discharging selected patients as early as 24 to 48 hours post-surgery, which represents a notable shift towards optimizing patient flow without compromising care quality. While the current body of evidence robustly

supports the integration of locoregional anesthesia in achieving these outcomes, it also highlights the necessity for continued research. Future studies should not only delve deeper into underexplored analgesic techniques but also consider the economic implications of these strategies more thoroughly. By addressing these research gaps, there's an opportunity to refine ERAS protocols further, particularly in facilitating safe and early discharge for suitable patients.

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