

2026 American Society of Anesthesiologists Practice Guideline on Perioperative Pain Management Using Local and Regional Analgesia for Cardiothoracic Surgeries, Mastectomy, and Abdominal Surgeries

Girish P. Joshi, M.B.B.S., M.D. (co-chair),
Edward R. Mariano, M.D., M.A.S. (co-chair),
Nabil M. Elkassabany, M.D., M.S.C.E., M.B.A.,
Monica Harbell, M.D., Rebecca L. Johnson, M.D.,
Jinlei Li, M.D., Ph.D., Lena Napolitano, M.D.,
Gary Schwartz, M.D., Santhanam Suresh, M.D., M.B.A.,
Karla E. Wyatt-Thompson, M.D., M.S.,
Anne Burns, B.Sc.Pharm. (patient representative),
Madhulika Agarkar, M.P.H., Anne Marbella, M.S.,
Stephanie Ramirez, M.A., M.P.H.,
Nancy Sullivan, B.S., Aaron Bloeschchak, M.S.,
Stacey Uhl, M.S., Karen B. Domino, M.D., M.P.H.

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ABSTRACT

This practice guideline addresses perioperative pain management using local and regional anesthesia for cardiothoracic, mastectomy, and abdominal surgery in adults and children. For adults, the American Society of Anesthesiologists (Schaumburg, Illinois) Task Force on Perioperative Pain Management strongly recommends fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively for open cardiothoracic, abdominal, retroperitoneal, and pelvic surgeries and mastectomy. Fascial plane blocks are also recommended in adults to reduce pain and/or opioid requirements after minimally invasive abdominal procedures. The Task Force conditionally recommends use of fascial plane blocks for minimally invasive cardiothoracic surgeries and open hernia repair to reduce pain in the first 24 h postoperatively. For children, the Task Force strongly recommends use of fascial plane blocks to reduce pain and/or opioid use after open cardiac or thoracic surgeries. Fascial plane blocks are conditionally recommended to reduce pain the first 24 h in children undergoing open hernia repair. Overall, data analysis for this practice guideline was limited by low methodologic quality, inconsistencies in outcome measurements, and small sample sizes from individual centers. Future research in regional anesthesia and analgesia needs to address these pervasive limitations.

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HIGHLIGHTS BOX

- This practice guideline provides evidence-based recommendations for perioperative pain management in adults and children undergoing cardiothoracic, mastectomy, and abdominal surgery. The guidance focuses on local and regional analgesia—key components of an optimal multimodal analgesia regimen. Primary outcome measures include postoperative pain scores and/or opioid requirements in the first 24 h.
- Fascial plane blocks are strongly recommended for adults undergoing open cardiothoracic, mastectomy, abdominal, retroperitoneal, and pelvic surgeries.
- Fascial plane blocks are recommended for adults undergoing minimally invasive abdominal procedures.
- Fascial plane blocks are conditionally recommended for adults undergoing minimally invasive cardiothoracic surgeries and open hernia repair.
- Fascial plane blocks are strongly recommended for children undergoing open cardiac or thoracic surgeries.
- Fascial plane blocks are conditionally recommended for children undergoing open hernia repair.

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Abbreviations: AHRQ, Agency for Healthcare Research and Quality; ASA, American Society of Anesthesiologists; COX-2, cyclooxygenase-2; GRADE, Grading of Recommendations, Assessment, Development, and Evaluation; MCID, minimal clinically important difference; NSAID, nonsteroidal anti-inflammatory drug; OME, oral morphine equivalents; QoR, quality of recovery

medical knowledge, technology, and practice. They provide basic recommendations supported by a synthesis and analysis of the current literature, expert and practitioner opinion, public comment, and clinical feasibility data.

Purpose

This practice guideline provides evidence-based recommendations regarding the appropriate management of perioperative pain. The guidance focuses primarily on regional analgesia and surgical site local anesthetic infiltration techniques as a component of a multimodal analgesia regimen. This guideline addresses approaches to minimizing the degree of postoperative pain and/or opioid requirements. The use of systemic analgesics that constitutes a crucial component of a multimodal analgesic technique for perioperative pain management is not addressed.

Background

Postoperative pain is often accompanied by physiologic and psychological stress responses with short-term and long-term consequences. Optimal perioperative pain management facilitates postoperative functional recovery (e.g., ambulation and rehabilitation) and thus is considered a prerequisite to enhancing recovery after surgery.^{1,2} Postoperative pain is a major concern reported by most surgical patients. Inadequate postoperative pain management is associated with chronic postsurgical pain, which can affect long-term quality of life. Unfortunately, there is a disturbingly high rate of suboptimal pain control with approximately 75% of surgical patients experiencing moderate to severe pain.³ Although the reasons for the lack of progress in pain management are multifactorial, inadequate clinical application of current knowledge is an important contributor.⁴ Another reason for the lack of improvement may be that existing guidelines provide broad recommendations

that may not always apply to different surgical locations and invasiveness.⁵ The guidance makes it difficult for clinicians to use the information in day-to-day practice.

Because pain is a complex and multifactorial phenomenon, a multimodal analgesic regimen that leverages a combination of nonopioid analgesics with different mechanisms of action is recommended.¹ While optimal analgesic combinations remain elusive, routine use of the combination of acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), or cyclooxygenase (COX)-2 specific inhibitors has been recommended unless there are contraindications.^{6,7} A multimodal analgesic strategy improves postoperative pain relief and reduces opioid requirements. Given that the recommendations for systemic analgesics are consistent for all surgical patients and procedures, the only component of an optimal multimodal analgesia strategy that remains variable is the use of regional analgesia and surgical site local anesthetic infiltration techniques. Therefore, the ASA Task Force on Perioperative Pain Management focused this systematic review on procedure-specific regional/local analgesia techniques.

Materials and Methods

The guideline task force included anesthesiologists with expertise in regional anesthesia, a general surgeon, a patient representative, and epidemiology-trained methodologists. ASA requires all task force members to disclose all relationships that might pose a conflict of interest. None of the disclosed relationships posed a conflict. The task force was responsible for developing key questions; defining the patient populations, interventions, comparators, and outcomes for each key question; and determining the importance of each outcome in relation to the decision-making process (see the study protocol in Supplemental Digital Content 1, <https://links.lww.com/ALN/E266>). A scale of 1 to 9 (1 to 3, limited importance; 4 to 6, important; and

Girish P. Joshi, M.B.B.S., M.D. (co-chair): Department of Anesthesiology and Pain Management, University of Texas Southwestern Medical School, Dallas, Texas.

Edward R. Mariano, M.D., M.A.S. (co-chair): Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University School of Medicine, Palo Alto, California.

Nabil M. Elkassabany, M.D., M.S.C.E., M.B.A.: Department of Anesthesiology, University of Virginia, Charlottesville, Virginia.

Monica Harbell, M.D.: Department of Anesthesiology and Perioperative Medicine, Mayo Clinic, Phoenix, Arizona.

Rebecca L. Johnson, M.D.: Department of Anesthesiology and Perioperative Medicine, Mayo Clinic, Rochester, Minnesota.

Jinlei Li, M.D., Ph.D.: Department of Anesthesiology, Yale University, New Haven, Connecticut.

Lena Napolitano, M.D.: American College of Surgeon's representative, Department of Surgery, University of Michigan Health System, Ann Arbor, Michigan.

Gary Schwartz, M.D.: Department of Anesthesiology, Maimonides Medical Center, Brooklyn, New York.

Santhanam Suresh, M.D., M.B.A.: Department of Anesthesiology and Perioperative Medicine, Loyola University Medical Center, Stritch School of Medicine, Maywood, Illinois.

Karla E. Wyatt-Thompson, M.D., M.S.: Department of Anesthesia, Cincinnati Children's Hospital, Cincinnati, Ohio.

Anne Burns, B.Sc.Pharm. (patient representative): Pharmacy Horizons, LLC, Great Falls, Virginia.

Madhulika Agarkar, M.P.H.: American Society of Anesthesiologists, Schaumburg, Illinois.

Anne Marbella, M.S.: American Society of Anesthesiologists, Schaumburg, Illinois.

Stephanie Ramirez, M.A., M.P.H.: American Society of Anesthesiologists, Schaumburg, Illinois.

Nancy Sullivan, B.S.: Contract Methodologist, Schaumburg, Illinois.

Aaron Bloshchick, M.S.: Contract Statistician, Schaumburg, Illinois.

Stacey Uhl, M.S.: American Society of Anesthesiologists, Schaumburg, Illinois.

Karen B. Domino, M.D., M.P.H.: Department of Anesthesiology and Pain Medicine, University of Washington, Seattle, Washington.

7 to 9, critical) was used to survey the task force.⁸ The evidence synthesis focused on outcomes rated as critical and important.

The systematic review supporting the development of the recommendations was guided by the following key questions:

- Key question 1: In patients undergoing elective or urgent surgeries, what are the effectiveness and harms of regional analgesia techniques compared with controls (e.g., no intervention, placebo, or sham)?
- Key question 2: In patients undergoing elective or urgent surgeries, what are the comparative effectiveness and harms of regional analgesia technique(s) compared with another regional analgesia technique(s)? Example: Peripheral nerve block compared with fascial plane block and/or surgical site local infiltration.

Populations, Interventions, Comparators, and Outcomes

In this section, we define the populations, interventions, comparators, and outcomes for each key question.

- Population: Patients of all ages undergoing open or minimally invasive elective or urgent abdominal, retroperitoneal, pelvic, intrathoracic, extrathoracic, or cardiac surgeries associated with substantive opioid requirements.

Interventions and comparators:

- Interventions: Neuraxial analgesia, paravertebral blocks, peripheral nerve blocks, fascial plane blocks (fig. 1), surgical site local infiltration or intraperitoneal instillation.
- Comparison: Key question 1: no intervention or sham block; and key question 2: another regional analgesia technique(s).
- Outcomes: Critical outcomes included pain at rest, dynamic pain, and total opioid use at 24 h postoperatively. Dynamic pain was defined as pain with cough or movement. Assessment tools for pain included but were not limited to the Visual Analog Scale; the Numeric Rating Scale; the Brief Pain Index; the Face, Legs, Activity, Cry

and Consolability scale; and the Children's Hospital of Eastern Ontario Pain Scale. Opioid use reported in milligrams or micrograms was converted to oral morphine equivalents using the University of California San Francisco calculator.⁹ Other outcomes rated as important included chronic pain beyond 3 months, quality of recovery, block-related complications, physical function, and patient and/or caregiver satisfaction.

Literature Search

Comprehensive searches were conducted for each key question by a medical librarian for literature published from January 2013 through June 2023 and updated in December 2024 using the following databases: PubMed, Embase, Scopus, and Cochrane. The search start date was chosen to preserve applicability of results and to focus on evidence published since ASA's previous guideline on acute pain management.^{10,11} In addition, task force members provided relevant references; citations in systematic reviews and meta-analyses were hand-searched; and trial registries were queried. The literature search strategy and Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) are available in the supplemental digital content (Supplemental Digital Content 2 [<https://links.lww.com/ALN/E267>] and Supplemental Digital Content 3 [<https://links.lww.com/ALN/E268>]).

The methodology used for this guideline for study screening, data extraction, and data management are similar to the methodology implemented in previous ASA guidelines and are described in the systematic review protocol (see Supplement Digital Content 1 [<https://links.lww.com/ALN/E266>] and Supplement Digital Content 4 [<https://links.lww.com/ALN/E269>]).^{12,13} Methodology specific to this guideline or requiring additional emphasis is presented in the "Evidence Synthesis and Statistical Analysis" section.

Risk of Bias Assessment

Risk of bias for randomized clinical trials was evaluated using the Cochrane risk of bias tool version 2 (Supplement Digital Content 5, <https://links.lww.com/ALN/E270>).¹⁴

Chest Wall Fascial Plane Blocks	Abdominal Wall Fascial Plane Blocks
Erector spinae plane block	External oblique intercostal plane block
Interpectoral plane block	Rectus sheath block
Parasternal intercostal plane block	Rhomboid intercostal plane block
Pectoserratus plane block	Transversus abdominis plane block
Serratus anterior plane block	Quadratus lumborum block

Fig. 1. Examples of ultrasound-guided fascial plane blocks indicated for surgeries involving the chest and abdomen.

Evidence Synthesis and Statistical Analysis

The results were organized by surgical approach (open surgeries, mastectomy, and minimally invasive surgeries) and then by area of surgery (cardiothoracic, upper or lower abdominal, among others). Results were further separated by block type (*e.g.*, neuraxial, paravertebral, fascial plane, local infiltration) and age group (adults [18 yr of age or older] and pediatric [younger than 18 yr]). Blocks were identified by the method of administration—single injection or continuous. We conducted pairwise meta-analysis when at least three studies reported on the same outcome at the same time point for a given intervention–comparison set. Analyses were conducted in STATA.¹⁵ For pain intensity and opioid use, the 24-h postoperative time point was meta-analyzed. Pain intensity was interpreted within the context of generally agreed upon threshold for a minimal clinically important difference (MCID). While thresholds for MCID vary in the acute pain literature, ranging from a difference of 8 to 40 mm on the visual analog scale of 0 to 100 mm,¹⁶ a well-conducted, larger cohort trial indicated that a difference of 10 mm as being of importance to patients.¹⁷

For this review, we defined MCID as a mean reduction in pain scores of at least 1 point on a scale of 0 to 10 mm (or 10 points on a scale of 0 to 100 mm).^{16–19} We did not define an MCID for reduction in opioid use as there is no generally accepted value applicable to wide range of surgeries. However, for quality of recovery, the MCIDs were 8 points for the QoR-15 scale and 6.3 points for the QoR-40 scale.¹⁷

We included randomized clinical trials that enrolled at least 60 adult patients (30 patients per arm). Given the paucity of studies assessing regional analgesia techniques in children, we considered randomized clinical trials with fewer than 60 patients and performed pooled analyses when the evidence base included at least two trials. Other details concerning the meta-analyses can be found in Supplemental Digital Content 4 (<https://links.lww.com/ALN/E269>; *e.g.*, choice of effect measure, pooling method, between-study variance estimators, examination of small study effects, prediction intervals, and other considerations).

Strength of Evidence

Methodologists rated the overall strength of evidence by comparators and outcomes using the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) system of rating evidence from high to very low.²⁰ Evidence from randomized clinical trials start at high strength of evidence and downgraded based on summary study-level risk of bias, inconsistency, indirectness, imprecision, with other considerations including small study effect due to suspected publication bias (Supplemental Digital Content 4, <https://links.lww.com/ALN/E269>).²¹

Strength of Recommendations

For each key question, the results of the evidence synthesis for important benefits and harms were summarized. Randomized clinical trials were used for analysis when assessing outcomes and developing recommendations. After reviewing the evidence summary and relevant details, the task force drafted recommendations and rated the corresponding strength consistent with the body of evidence. Strong recommendations include high to moderate level of evidence when the guideline task force believes that all or almost all clinicians would choose (or not) the specific action or approach. Conditional recommendations include low to very low level of evidence where most, but not all, clinicians would choose (or not choose) the action or approach.

Body of Evidence

The overall evidence base consisted of 628 randomized clinical trials (see Supplemental Digital Content 3 [<https://links.lww.com/ALN/E268>] for overall number of studies screened and reasons for exclusion). Of these, 124 trials contributed data to one or more pooled analyses to assess the efficacy of a specific regional technique compared with a sham or no intervention control for developing recommendations (table 1). Study and patient characteristics are presented in the appendix and in Supplemental Digital Content 6 (<https://links.lww.com/ALN/E271>). We also conducted analyses comparing one type of regional technique to another (*e.g.*, fascial plane block *vs.* epidural analgesia). However, for most of these comparisons, the results of our analyses indicated that there were no differences in outcomes. Results of the pooled analyses comparing one technique to another are presented in Supplemental Digital Content 7 (<https://links.lww.com/ALN/E272>). The evidence synthesis for this guideline excluded comparative assessment of various fascial plane blocks.

The evidence for fascial plane blocks used in open and minimally invasive cardiothoracic surgeries comes from a systematic review conducted by the Agency for Healthcare Research and Quality (AHRQ), in collaboration with methodologists from ASA.²² The AHRQ report was developed for a broader audience, and as such, some of its methodologic approaches and clinical assumptions differed from those underlying the ASA's guideline. For example, the ASA guideline Task Force concluded that the incision sites and pain levels of cardiac and thoracic procedures were similar enough to be categorized together as “cardiothoracic surgeries”—an approach also applied to abdominal procedures. In contrast, the AHRQ review analyzed these surgical types separately. The ASA grouped all fascial plane blocks into a single intervention category, while the AHRQ report analyzed individual blocks separately. The ASA combined “no block” and “sham block” into a single control group, while AHRQ treated them as separate comparators. There was also a difference in how the MCID was defined: AHRQ

used a threshold of 1.5 points on a 10-point scale, whereas ASA used 1.0 point.

Despite these differences, the overall conclusions of the two reviews were largely consistent. To better align with the ASA's framework, AHRQ conducted *post hoc* analyses that grouped all fascial plane blocks as a single intervention, merged no block and sham block into one control group, and combined cardiac and thoracic procedures into a single category.²²

Open Truncal Surgeries in Adults

Recommendations

Recommendation 1: For adults undergoing open cardiothoracic surgeries including lobectomy, aortic valve

replacement, coronary artery bypass grafts, mitral valve repair, or septal repair, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively.

- Strength of recommendation: Strong
- Strength of evidence: Moderate

Recommendation 2: For adults undergoing open abdominal, retroperitoneal, and pelvic surgeries, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively. Fascial plane blocks also improve patient satisfaction.

- Strength of recommendation: Strong
- Strength of evidence: Moderate

Table 1. Recommendation Statements

Recommendation	Strength of Recommendation	Strength of Evidence
Open surgeries		
1. For adults undergoing open cardiothoracic surgeries including lobectomy, aortic valve replacement, coronary artery bypass graft, mitral valve repair, and septal repair, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively.	Strong	Moderate
2. For adults undergoing open abdominal, retroperitoneal, and pelvic surgeries, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively. Fascial blocks also improve patient satisfaction.	Strong	Moderate
Mastectomy		
3. For adults undergoing mastectomy, we recommend fascial plane or paravertebral blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively. Fascial plane blocks also improve patient satisfaction and quality of recovery.	Strong	Moderate
Minimally invasive surgeries		
4. For adults undergoing minimally invasive cardiothoracic surgeries including lobectomy, valve repair/replacement, and esophageal procedures, we suggest regional techniques including neuraxial and fascial plane blocks to reduce pain in the first 24 h postoperatively.	Conditional	Low
5. For adults undergoing minimally invasive abdominal surgeries including cholecystectomy, appendectomy, bariatric, gastrectomy, and liver resection surgeries, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively.	Strong	Moderate
6. For adults undergoing minimally invasive hernia repair, we suggest fascial plane blocks to reduce pain in the first 24 h postoperatively.	Conditional	Low
Pediatrics		
7. For children (younger than 18 yr) undergoing open cardiothoracic surgeries, we recommend fascial plane blocks to reduce pain and/or opioid use in the first 24 h postoperatively.	Strong	Moderate
8. For children (younger than 18 yr) undergoing open hernia repair, we suggest a fascial plane block to reduce pain in the first 24 h postoperatively.	Conditional	Low

Table 2. Summary of Evidence for Pain and Opioid Use for Open Cardiothoracic Surgeries in Adults: Single-injection Fascial Plane Block *versus* Control

Patient Outcomes	Studies (Patients)	Effect	Estimate (95% CI)	Strength of Evidence
Pain at rest 24 h	5 (535)	MD	−1.33 (−1.99 to −0.67)	Moderate
Opioid use 24 h	8 (730)	MD	−60.35 (−88.54 to −32.16)	Moderate

Effect estimates for pain are reported on a scale of 0 to 10 points, and opioid use is reported as oral morphine equivalents. Fascial plane blocks included erector spinae plane, pecto-intercostal, serratus anterior plane, and superficial parasternal intercostal plane.

MD, mean difference.

Summary of Evidence for Critical and Important Outcomes: Open Cardiothoracic Surgeries

Pooled results from five randomized clinical trials assessing pain intensity showed that fascial plane blocks led to a reduction in pain at 24h postoperatively that exceeded the MCID of 1 point (table 2).^{23–27} Similarly, pooled analysis of eight trials showed that fascial plane blocks reduced the use of opioids compared to controls with a mean difference of 60 oral morphine equivalents (OME; table 2).^{24,25,27–32} The overall strength of evidence for both pain intensity and opioid use was rated moderate due to risk of bias limitations primarily related to lack of blinding of patients and/or outcome assessors²² (see the appendix for further information about the trials included in the analyses and Supplemental Digital Content 6 [https://links.lww.com/ALN/E271] for study and patient characteristics, GRADE assessments, and meta-analysis results).

Comment

We recommend incorporating fascial plane blocks into the multimodal analgesic regimen for patients undergoing open cardiothoracic surgeries based on decreased pain at rest and decreased opioid use within 24h. The mean difference in pain scores in patients who received a block exceeded the MCID threshold of 1 point when compared to controls. It should be noted that the variety of block techniques described in the included studies cover different regions of the chest,³³ and the choice of block should be influenced by surgical approach and site of anticipated pain (*i.e.*, parasternal intercostal plane blocks for sternotomy pain). We also recognize that there is controversy within the regional anesthesia community regarding the appropriate use and efficacy of the erector spinae plane block.^{34–36} However, the erector spinae plane block is not consistently performed the same way between regional anesthesia practitioners, and a variety of factors may influence the distribution of injectate and clinical effects.^{37–39}

Summary of Evidence for Critical and Important Outcomes: Open Abdominal Surgeries

Pooled analysis of 22 randomized clinical trials suggests that fascial plane blocks reduced pain at rest,^{40–61} 10 trials suggest

reduction of dynamic pain^{42,44,47,48,50–53,60,61} and 11 trials showed a reduction in opioid use^{41,45–47,50,51,53,58,60,62,63} at 24h postoperatively compared with controls (table 3). While the reduction in pain intensity was modest, the reduction in opioid use for fascial plane blocks was 35 OME. A pooled analysis of five trials indicated that fascial plane blocks were also associated with an increase in patient satisfaction.^{48,50,56,59,63} The overall strength of evidence for pain intensity and/or opioid use was moderate due to either risk of bias limitations related to lack of blinding or to imprecision (*i.e.*, the 95% CI for dynamic pain overlaps with the MCID threshold; see the appendix for further information about the trials included in the analyses and Supplemental Digital Content 6 [https://links.lww.com/ALN/E271] for study and patient characteristics, GRADE assessments, and meta-analysis results).

Comment

We recommend fascial plane blocks to reduce pain and/or opioid requirements and improve patient satisfaction for adults undergoing open abdominal, retroperitoneal, and pelvic surgeries. It is noteworthy that analgesic benefits were observed, although there was significant variability in the randomized clinical trials reviewed, including the specific operative procedure, the specific regional block performed (*e.g.*, transversus abdominis plane, quadratus lumborum), the analgesic type/dose and injection site used, the specific timing of the block (preoperative, before fascial closure), and whether the block was performed by the anesthesiologist or the operating surgeon. Similarly, a reduction in opioid use with fascial plane blocks was found despite variability in the postoperative analgesic regimen in the control cohort, ranging from opioids alone to nonopioids analgesics, acetaminophen, NSAIDs, and COX-2-specific inhibitors.

Other systematic reviews focused on single surgical procedures and comparisons of specific blocks in those procedures have reported variable findings. For example, fascial plane blocks reduced pain and/or opioid use after hysterectomy and open ventral hernia repair but not after liver surgery.^{64,65} The analgesic efficacy of fascial plane blocks in open inguinal hernia repair is difficult to ascertain because these procedures are commonly performed under local or

Table 3. Summary of Evidence for Pain, Opioid Use, and Patient Satisfaction for Open Abdominal, Retroperitoneal, and Pelvic Surgeries in Adults: Single-injection Fascial Plane Block *versus* Control

Patient Outcomes	Studies (Patients)	Effect	Estimate (95% CI)	Strength of Evidence
Pain at rest 24 h	22 (1,692)	MD	−0.68 (−0.91 to −0.44)	Moderate
Dynamic pain 24 h	10 (800)	MD	−0.78 (−1.28 to −0.27)	Moderate
Opioid use 24 h	11 (805)	MD	−35.30 (−61.34 to −9.26)	Moderate
Patient satisfaction	5 (446)	SMD	2.59 (1.39 to 3.80)	Moderate

Effect estimates for pain are reported on a scale of 0 to 10 points, and opioid use is reported as oral morphine equivalents. Fascial plane blocks included erector spinae, transversus abdominis, quadratus lumborum, and intercostal plane.

MD, mean difference; SMD, standardized mean difference.

regional anesthesia. This has precluded us from providing any specific recommendations regarding regional analgesic blocks for patients undergoing open inguinal hernia repair.

Mastectomy

Recommendations

Recommendation 3: For adults undergoing mastectomy, we recommend fascial plane or paravertebral blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively. Fascial plane blocks also improve patient satisfaction and quality of recovery.

- Strength of recommendation: Strong
- Strength of evidence: Moderate

Summary of Evidence for Critical and Important Outcomes: Mastectomy

Pooled analysis of 20 randomized clinical trials showed that fascial plane blocks reduced pain at rest^{66–85} and 11 trials showed that they also reduced dynamic pain at 24 h.^{69,70,73,75,76,80,82,84–87} However, the reduction in pain met the MCID of 1 point for dynamic pain but not for pain at rest (table 4). Nine randomized clinical trials showed a reduction in pain at rest^{69,74,88–94} with paravertebral block, and four trials achieved a MCID of 1-point in dynamic pain.^{69,89,95,96} Pooled analysis of 18 trials for fascial plane blocks^{66–69,72–76,78–80,82,83,85,97–99} and 5 trials for paravertebral blocks^{69,74,91,93,95} showed that both were associated with a reduction in opioid use in the first 24 h after surgery, with a decrease of 25 OME.

While no trials involving paravertebral blocks assessed quality of recovery, pooled analysis indicated that fascial plane blocks were associated with improved quality of recovery^{68,78,99} and higher patient satisfaction.^{69,73,80,99} The evidence for fascial plane blocks was rated moderate due primarily to risk of bias

limitations related to inadequate randomization (*e.g.*, lack of allocation concealment). The evidence for paravertebral blocks was rated low due to limitations in risk of bias, inconsistency (*e.g.*, variation in the magnitude or direction of effect of individual studies in the pooled analysis), and/or imprecision (95% CI crossing the null or MCID threshold; see the appendix for further information about the trials included in the analyses and Supplemental Digital Content 6 [<https://links.lww.com/ALN/E271>] for study and patient characteristics, GRADE assessments, and meta-analysis results).

Comment

Evidence suggests that fascial plane and paravertebral blocks provide effective analgesia after mastectomy. Although there were no differences between paravertebral block and fascial plane blocks (see Supplemental Digital Content 7, <https://links.lww.com/ALN/E272>), fascial plane blocks were associated with improved quality of recovery and patient satisfaction. These findings are consistent with previous systematic reviews and meta-analyses reporting that paravertebral block and fascial plane blocks were superior to control or surgical site local anesthetic infiltration for reducing postoperative pain and opioid use.¹⁰⁰

Minimally Invasive Truncal Surgeries in Adults

Recommendations

Recommendation 4: For adults undergoing minimally invasive cardiothoracic surgeries including lobectomy, valve repair/replacement, and esophageal procedures, we suggest regional techniques including neuraxial and fascial plane blocks to reduce pain in the first 24 h postoperatively.

- Strength of recommendation: Conditional
- Strength of evidence: Low

Table 4. Summary of Evidence for Pain, Opioid Use, Patient Satisfaction, and Quality of Recovery for Mastectomy in Adults

Patient Outcomes	Studies (Patients)	Effect	Estimate (95% CI)	Strength of Evidence
Fascial plane block—single injection				
Pain at rest 24 h	20 (1,611)	MD	−1.09 (−1.42 to −0.76)	Moderate
Dynamin pain 24 h	11 (1,116)	MD	−1.30 (−1.88 to −0.72)	Moderate
Opioid use 24 h	18 (1,314)	MD	−25.82 (−36.28 to −15.35)	Moderate
QoR-40	3 (184)	MD	11.79 (7.87 to 15.70)	Moderate
Patient satisfaction	4 (377)	SMD	2.01 (0.34 to 3.68)	Moderate
Paravertebral block—single injection				
Pain at rest 24 h	9 (882)	MD	−0.80 (−1.41 to −0.18)	Low
Dynamin pain 24 h	4 (314)	MD	−1.18 (−2.62 to 0.27)	Low
Opioid use 24 h	5 (316)	MD	−28.27 (−39.78 to −16.76)	Moderate
Patient satisfaction	3 (255)	SMD	0.87 (0.19 to 1.56)	Low

Effect estimates for pain are reported on a 0 to 10-point scale, and opioid use is reported as oral morphine equivalents. Fascial plane blocks included erector spinae plane, interpectoral plane, pectoserratus plane, and serratus anterior plane.

MD, mean difference; QoR, quality of recovery; SMD, standardized mean difference.

Recommendation 5: For adults undergoing minimally invasive abdominal surgeries including cholecystectomy, appendectomy, bariatric, gastrectomy and liver resection surgeries, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively.

- Strength of recommendation: Strong
- Strength of evidence: Moderate

Recommendation 6: For adults undergoing minimally invasive hernia repair, we suggest fascial plane blocks to reduce pain in the first 24 h postoperatively.

- Strength of recommendation: Conditional
- Strength of evidence: Low

Summary of Evidence for Critical and Important Outcomes: Minimally Invasive Cardiothoracic Surgeries

Pooled analyses of 20 trials for single-injection fascial plane blocks^{101–122} and 6 trials for continuous fascial plane blocks showed a reduction in pain at 24 h,^{105,123–127} but the reduction did not meet the MCID of 1 point (table 5).²² However, single-injection fascial plane blocks were associated with a reduction in opioid use by 37 OME.^{128–130} Pooled analyses of six trials showed that continuous epidural analgesia reduced both pain at rest and dynamic pain at 24 h exceeding the MCID of 1 point.^{131–136} While six trials showed that single-injection paravertebral blocks were associated with only a modest reduction in pain, further analyses of these trials indicated a 33 OME reduction in opioid use.^{137–142} Pooled analyses showed a reduction in pain at rest that met the MCID of 1 point^{143–145} but not for dynamic pain^{143,144,146} with continuous paravertebral block. The overall strength of

evidence was rated low for most outcomes due to risk of bias and imprecision (95% CI crossed the MCID threshold²²; see the appendix for further information about the trials included in the analyses and Supplemental Digital Content 6 [<https://links.lww.com/ALN/E271>] meta-analysis results).

Comment

For minimally invasive cardiothoracic surgeries, we suggest the inclusion of neuraxial or fascial plane blocks within a multimodal analgesic regimen to decrease pain after surgery. The conditional recommendation is due to the overall low strength of evidence, mainly attributable to risk of bias. However, studies of single-injection paravertebral and fascial plane blocks show clinically relevant reductions in opioid use for the first 24 h after surgery. The opioid-sparing effect may be important to consider for cardiothoracic surgery patients as they are at higher risk for postoperative respiratory compromise. While continuous epidural demonstrated clinically relevant reductions in pain at rest and dynamic pain that exceeded the MCID, this technique is not recommended for minimally invasive thoracic surgery by the Procedure Specific Postoperative Pain Management group and others.^{147,148} As an alternative, for patients who may benefit from extending the duration of local anesthetic effect, continuous paravertebral block may offer clinically relevant analgesia at rest.

Summary of Evidence for Critical and Important Outcomes: Minimally Invasive Abdominal Surgeries

Minimally invasive abdominal surgeries were grouped based on incision site and pain intensity. The body of evidence included 62 randomized clinical trials.^{54,149–209} Pooled analysis showed a reduction in pain intensity and opioid use in all

Table 5. Summary of Evidence for Pain and Opioid Use for Minimally Invasive Cardiothoracic Surgeries in Adults

Patient Outcomes	Studies (Patients)	Effect	Estimate (95% CI)	Strength of Evidence
Fascial plane block–single injection				
Pain at rest 24 h	20 (1,713)	MD	−0.69 (−0.94 to −0.45)	Low
Opioid use 24 h	9 (789)	MD	−37.55 (−56.86 to −18.24)	Low
Fascial plane block–continuous				
Pain at rest 24 h	6 (523)	MD	−0.95 (−1.15 to −0.75)	Low
Opioid use 24 h	3 (210)	MD	−13.93 (−49.53 to 21.70)	Very low
Epidural–continuous				
Pain at rest 24 h	6 (739)	MD	−1.02 (−1.57 to −0.46)	Very low
Dynamic pain 24 h	5 (657)	MD	−1.47 (−2.30 to −0.63)	Moderate
Paravertebral block–single injection				
Pain at rest 24 h	6 (717)	MD	−0.75 (−0.95 to −0.55)	Low
Dynamic pain 24 h	6 (732)	MD	−0.78 (−1.27 to −0.27)	Low
Opioid use 24 h	3 (185)	MD	−33.34 (−54.28 to −12.41)	Low
Paravertebral block–continuous				
Pain at rest 24 h	3 (521)	MD	−1.18 (−2.62 to 0.25)	Very low
Dynamic pain 24 h	3 (353)	MD	−0.46 (−0.88 to −0.04)	Low

Effect estimates for pain are on a scale of 0 to 10 points, and opioid use is reported as oral morphine equivalents. Fascial plane blocks included erector spinae plane, intercostal plane, and serratus anterior plane.

MD, mean difference.

Table 6. Summary of Evidence for Pain and Opioid Use for Minimally Invasive Abdominal, Retroperitoneal, or Pelvic Surgeries in Adults: Single-injection Fascial Plane block *versus* Control

Patient Outcomes	Studies (Patients)	Effect	Estimate (95% CI)	Strength of Evidence
Nephrectomy and urologic surgeries				
Pain at rest 24 h	6 (415)	MD	−0.82 (−1.42 to −0.22)	Moderate
Dynamic pain 24 h	5 (335)	MD	−0.62 (−0.99 to −0.25)	High
Opioid use 24 h	3 (222)	MD	−11.55 (−17.90 to −5.20)	Moderate
QoR-15	3 (168)	MD	10.96 (0.01 to 21.91)	Low
Appendectomy, bariatric, and cholecystectomy				
Pain at rest 24 h	23 (2,042)	MD	−0.84 (−1.19 to −0.49)	Moderate
Dynamic pain 24 h	13 (1,117)	MD	−0.92 (−1.23 to −0.61)	Moderate
Opioid use 24 h	16 (801)	MD	−24.91 (−33.85 to −15.97)	Moderate
QoR-40	5 (460)	MD	7.87 (3.29 to 12.45)	Moderate
Patient satisfaction	3 (229)	SMD	0.32 (0.06 to 0.57)	Moderate
Colorectal, hysterectomy, and other gynecologic				
Pain at rest 24 h	20 (1,555)	MD	−0.40 (−0.72 to −0.08)	High
Dynamic pain 24 h	13 (1,038)	MD	−0.77 (−1.28 to −0.25)	Moderate
Opioid use 24 h	16 (1,375)	MD	−17.78 (−31.42 to −4.14)	Moderate
Gastrectomy, liver resection, pancreatic, and splenectomy				
Pain at rest 24 h	9 (735)	MD	−0.70 (−0.98 to −0.42)	Moderate
Dynamic pain 24 h	6 (514)	MD	−0.76 (−1.16 to −0.35)	Low
Opioid use 24 h	3 (301)	MD	−45.38 (−70.36 to −20.39)	Moderate
Hernia repair				
Pain at rest 24 h	4 (352)	MD	−1.08 (−1.87 to −0.28)	Low

Effect estimates for pain are reported on a scale of 0 to 10 points, and opioid use is reported as oral morphine equivalents. Fascial plane blocks included erector spinae plane, quadratus lumborum, rectus sheath, serratus anterior plane, and transversus abdominis plane.

MD, mean difference; QoR, quality of recovery; SMD, standardized mean difference.

surgical groups, but the reduction in pain did not meet the MCID threshold (table 6). Pooled analysis of three trials indicated higher quality of recovery with fascial plane blocks that met the MCID threshold for nephrectomy.^{174,209,210} Similarly, five trials showed higher quality of recovery for appendectomy surgical subgroups, but the difference did not meet the MCID threshold.^{150,151,170,193,199} The strength of evidence was moderate due to risk of bias (allocation concealment and blinding) and inconsistency due to variation in the magnitude of effect (see the appendix for further information about the trials included in the analyses and Supplemental Digital Content 6 [<https://links.lww.com/ALN/E271>] for study and patient characteristics, GRADE assessments, and meta-analysis results).

Comment

Minimally invasive abdominal surgeries have become increasingly common across a broad range of surgical specialties, including urologic, gastrointestinal, bariatric, gynecologic, and hepatobiliary, due to established benefits of smaller incisions, reduced surgical stress response, and faster recovery, while appreciating lower risks of complications compared to open procedures.^{211–213} Compared with an open surgical approach, a minimally invasive approach is associated with lower postoperative pain and opioid requirements.^{214,215} We grouped different types of minimally invasive surgical procedures because these procedures have almost similar surgical incisions, resulting in similar intensity of somatic pain, although visceral pain may vary. It is generally accepted that fascial plane blocks reduce

somatic pain but minimally influence visceral pain.²¹⁶ Notably, despite not yet fully understanding their mechanisms of action,²¹⁷ fascial plane blocks resulted in a reduction in opioid usage consistently across all surgical categories.

Open Truncal Surgeries in Children (Younger than 18 yr)

Recommendations

Recommendation 7: For children (younger than 18 yr) undergoing open cardiothoracic surgeries, we recommend fascial plane blocks to reduce pain and/or opioid requirements in the first 24 h postoperatively.

- Strength of recommendation: Strong
- Strength of evidence: Moderate

Recommendation 8: For children (younger than 18 yr) undergoing open hernia repair, we suggest fascial plane blocks to reduce pain in the first 24 h postoperatively.

- Strength of recommendation: Conditional
- Strength of evidence: Low

Summary of Evidence for Critical and Important Outcomes: Open Cardiothoracic Surgeries in Children (Younger than 18 yr)

Pooled analysis of seven trials found that fascial plane blocks reduced opioid use within the first 24 h^{218–224} and six trials

reported minimal pain reduction within the first 12 to 24 h (table 7).^{218–220,224–226} The strength of evidence rating for reduced opioid use was moderate due to study risk of bias (lack of patient or observer blinding) and low for pain due to limitations in risk of bias and imprecision for study and patient characteristics, GRADE assessments, and meta-analysis results (see the appendix for further information about the trials included in the analyses and Supplemental Digital Content 6 [<https://links.lww.com/ALN/E271>] for study and patient characteristics, GRADE assessments, and meta-analysis results).

Comment

We recommend the incorporation of fascial plane blocks into the multimodal analgesic regimen to reduce pain and/or opioid use and improve recovery in infants and children undergoing cardiothoracic surgery. However, the following limitations to the evidence should be noted. The pain assessments coalesced in this meta-analysis reflect a variety of acceptable, but not necessarily interchangeable scoring systems including the Modified Objective Pain Scale; Face, Legs, Activity, Cry and Consolability scale; and the Numeric Rating Scale. Confounding factors, like postoperative delirium or agitation and operator or parenteral interpretation, can bias the score reporting and further skew cohort results. Another noteworthy consideration is the lack of standardized sensory testing for block efficacy, which is not uniformly assessed in the postoperative period for the pediatric population. As a result, block efficacy is often presumed and not definitively investigated, further hindering the formulation of robust recommendations for widespread practice.

There is a significant dearth of data in support of regional analgesic techniques for children undergoing cardiac surgery. The sample sizes of these studies were typically small and when compared to adult studies, large multicenter trials are lacking. Databases including the Pediatric Regional Anesthesia Network provide voluntary observational data collected prospectively to provide information on safety and dosing guidelines based on large cohorts of peripheral and neuraxial blocks.²²⁷ Single-injection thoracic paravertebral blocks have demonstrated similar outcomes in reduced

postoperative pain scores, opioid requirements, and rapid recovery after pediatric cardiac surgery when compared to postoperative opioids. Over the last decade, the utilization of paravertebral and neuraxial techniques for congenital heart surgery has been surpassed by ultrasound-guided fascial plane blocks, which are facile and minimize the risks associated with systemic anticoagulation. Rigorous prospective studies with comparable methodologies are needed to provide objective criteria across large cohorts specific to median sternotomies and thoracotomies in the pediatric population.

Summary of Evidence for Critical and Important Outcomes: Open Abdominal Surgeries for Children (Younger than 18 yr)

The body of evidence included two randomized clinical trials comparing single-injection fascial plane blocks (erector spinae plane and quadratus lumborum) to controls.^{228,229} Both trials utilized opioids, with NSAIDs and acetaminophen adjuncts for postoperative pain management. Pooled analysis suggests that fascial plane blocks reduced pain within the first 12 to 24 h postoperative (table 8). The overall strength of evidence for pain intensity was low due to risk of bias limitations and imprecision due to the small number of studies included in the evidence base (see the appendix for further information about the trials included in the analyses and Supplemental Digital Content 6 [<https://links.lww.com/ALN/E271>] for study and patient characteristics, GRADE assessments, and meta-analysis results).

Comment

We suggest the incorporation of fascial plane or peripheral nerve blocks to reduce pain and opioid use in children undergoing open inguinal hernia repair surgery. The studies analyzed herein lacked sensory assessments (efficacy), utilized different pain assessment scales (Numeric Rating Scale *vs.* Face, Legs, Activity, Cry and Consolability scale), and compared caudal analgesia for children aged 2 to 5 yr old, for which a shorter duration of action/spread with local anesthetic and hence postoperative rescue opioid

Table 7. Summary of Evidence for Pain and Opioid Use for Open Cardiac Surgeries *via* Median Sternotomy or Thoracotomy in Children (Younger than 18 yr): Single-injection Fascial Plane Block *versus* Control

Patient Outcomes	Studies (Patients)	Effect	Estimate (95% CI)	Strength of Evidence
Pain at rest 12 h	6 (386)	SMD	−1.00 (−1.53 to −0.46)	Moderate
Pain at rest 24 h	6 (426)	SMD	−0.88 (−1.27 to −0.49)	Low
Opioid use 24 h	7 (458)	MD	−19.46 (−33.83 to −5.09)	Moderate

Effect estimates for pain are reported on a scale of 0 to 10 points, and opioid use is reported as oral morphine equivalents. Fascial plane blocks included erector spinae plane, intercostal plane, interpectoral plane, pectoserratus plane, retrolaminar, serratus anterior plane, and transversalis fascia plane.

MD, mean difference; SMD, standardized mean difference.

Table 8. Summary of Evidence for Pain for Open Hernia Repair in Children (Younger than 18 yr): Single-injection Fascial Plane Block *versus* Control

Patient Outcomes	Studies (Patients)	Effect	Estimate (95% CI)	Strength of Evidence
Pain at rest 12 h	2 (125)	SMD	−1.49 (−3.15 to 0.16)	Very low
Pain at rest 24 h	2 (125)	SMD	−0.96 (−1.71 to −0.22)	Very low

Effect estimates for pain are reported on a 0 to 10-point scale, and opioid use is reported as oral morphine equivalents. Fascial plane blocks included erector spinae and quadratus lumborum plane.

SMD, standardized mean difference.

use would be predictable. Caudal block is the most widely utilized regional technique for children undergoing lower abdominal surgery. Current trends suggest more interest in adjunct fascial plane blocks for lower abdominal pediatric surgery, as these offer prolonged localized coverage without the inherent systemic risks associated with caudal anesthesia.²³⁰ A concerted effort by pediatric anesthesiologists to collate larger, multi-institutional data may yield the necessary outcomes to validate incorporating more fascial plane and peripheral nerve blocks into pediatric acute postsurgical management.

Limitations of the Evidence Base

Our ability to make stronger recommendations for many of the regional analgesia techniques assessed in this guideline was largely limited by reporting inconsistencies, poor methodologic quality, and small sample sizes of the included studies. Studies varied in how outcomes such as pain intensity and opioid use were measured and reported. For instance, pain intensity was assessed using various tools (e.g., visual analog scales, numerical rating scales, or ordinal scales) and sometimes reported in formats unsuitable for our meta-analysis (e.g., maximum pain, area under the curve, or combined dynamic and resting pain). Total opioid use in the first 24 h was not consistently reported in studies, with several studies reporting opioids that were not included in the OME conversion table, combining opioids and nonopioids, or not clearly indicating the timeframe for opioid use. Studies also varied in the metric used to report total opioid use (e.g., milligrams/kilograms, micrograms/kilograms). There were also inconsistencies in block nomenclature and techniques' description. For example, what was described as transverse abdominis plane block could have been different across different studies, which may make pooling the data and generating a conclusion challenging. These limitations, along with a lack of reporting of other important patient-oriented outcomes, such as quality of recovery, patient satisfaction with pain management, and harms, limited the robustness of our meta-analyses.

Most studies contributing to the meta-analyses had methodologic limitations primarily related to biases in the randomization process and outcome measurement. Studies

did not always report on how patients were randomized or whether there was allocation concealment. Similarly, many studies did not blind patients, clinicians, or outcome assessors or did not report the method of blinding. Blinding patients and outcome assessors is particularly important in studies measuring pain as pain is a subjective experience and blinding can mitigate the influence of expectations and perceptions on outcomes. These shortcomings were further compounded by missing data (e.g., studies not reporting outcome data for full sample) and relatively small sample sizes of most studies contributing to the meta-analyses.

Ultimately, these and other limitations affected the overall strength of evidence for most comparisons and outcomes assessed in the meta-analyses. The low rating of the strength of evidence was largely due to the described reporting limitations and risk of bias concerns, which contributed to the overall heterogeneity and limited precision of the findings of our pooled analyses. In many of the meta-analyses, the magnitude of the estimated effects of the individual studies varied considerably, with some studies indicating large differences in pain intensity or opioid consumption and others suggesting small or no difference. Additionally, in many of the meta-analyses, the estimated effect did not meet the threshold for a MCID, or the 95% CI overlapped with the threshold.

Future Direction

Given the rigorous process involved in conducting systematic reviews and meta-analyses and developing clinical practice guidelines, there is a need for larger, high-quality randomized clinical trials that consistently measure meaningful outcomes related to perioperative pain management. These outcomes should include both unidimensional and multidimensional assessments, as pain affects various aspects of daily life, such as function, sleep, emotions, and other activities and cannot be fully captured by assessment of pain intensity within a single time point or interval. In addition, studies that involve regional anesthesia and pain management interventions need to move beyond the immediate 24-h postoperative period. From available pain trajectory data, resolution of moderate to severe pain after surgery, which limits mobility and other rehabilitative goals, can last

several days to weeks based on the patient and procedure. Ongoing efforts are underway to improve regional anesthesia and perioperative pain management research, with some progress made in the establishment of a core set of outcome domains,²³¹ as well as prioritized “top 10” lists of key regional anesthesia research questions that could guide the direction of future studies. Additionally, the nomenclature and anatomical description of truncal blocks are now standardized for reference to clinicians and researchers to use them consistently.^{232–234}

While the strength of some of the recommendations in the current guideline were rated “conditional,” this rating reflects the lack of robust evidence and should not be interpreted as dismissing the potential benefit of a technique. To improve the robustness of evidence, studies of perioperative pain management interventions should adopt standardized and validated assessment tools and consider MCID in outcomes in their research designs.

The current guideline focused on regional and surgical site local anesthetic infiltration techniques, which constitute one component of multimodal analgesia. Task force members wish to emphasize that acute perioperative pain management depends on routine and consistent use of basic analgesics.¹ However, evidence suggests that adherence to multimodal analgesic protocols is inconsistent.²³⁵ Peripheral nerve blockade continues to be underutilized even for procedures in which there is sufficient evidence to support its use, and there may be multiple contributing factors.^{236,237} Even when there are evidence-based guidelines available, there may be a long time lag before clinical practice changes.²³⁸ Thus, a critical next step in this work is implementation, which may include standardization of best practices, while allowing for personalization; monitoring for patient safety and risk mitigation; disseminating education on regional anesthesia techniques and the integration of nerve blocks into multimodal analgesia protocols; ensuring equitable access to high quality acute pain services that offer regional anesthesia techniques; and an enhanced focus on patient-centered outcomes and patient experience.

Conclusions

This practice guideline makes clinical recommendations about perioperative pain management with the aim of improving postoperative pain relief and reducing postoperative opioid use. The guidance focused on regional analgesia—a key component of an optimal multimodal analgesia regimen. A procedure-specific approach to the choice of regional analgesia technique (fascial plane blocks for most procedures) considers the differences in the pathophysiology of pain, the magnitude of the injury (*e.g.*, open *vs.* minimally invasive approaches or vertical incision *vs.* horizontal incision), site of intervention (somatic or visceral), and the type of tissue involved (*i.e.*, muscle, bone, or joint). In addition, the choice of regional analgesic technique should be influenced by patient factors (*e.g.*, patient choice, anatomy,

anticoagulation status) and clinical factors (*e.g.*, training and experience with the block).

Appendix

Open Cardiothoracic Surgeries

The body of evidence included 10 randomized clinical trials of patients scheduled for open cardiac and thoracic surgery with sternotomy under general anesthesia comparing fascial plane blocks to controls (no block or placebo).^{23–32} These included lobectomy, coronary artery bypass graft, and aortic or mitral valve replacement. Fascial plane blocks included single-injection erector spinae plane, pectointercostal, serratus anterior plane, and superficial parasternal intercostal plane.²² Local anesthetics administered were bupivacaine or ropivacaine.

Open Abdominal, Retroperitoneal, and Pelvic Surgeries

The evidence-base for open abdominal surgeries included 22 randomized clinical trials that compared fascial plane blocks with controls. Of these trials, 7 used opioids for postoperative pain management^{40,41,48,50,55,58,61} and 14 used opioids with at least one or more nonopioid analgesics, such as acetaminophen, NSAIDs, and COX-2 specific inhibitors,^{42–47,49–51,53,54,57,59,60} and one used only NSAIDs.⁵⁴

Open abdominal surgeries using either general or regional anesthesia included hysterectomy or other gynecologic surgeries (38%), liver resection (14%), nephrectomy or other renal/urologic surgeries (14%), gastrectomy (14%), colorectal (14%), radical prostatectomy (14%), appendectomy (5%), splenectomy (5%). Fascial plane blocks included single-injection erector spinae, transversus abdominis, quadratus lumborum, and intercostal plane. Local anesthetics administered were bupivacaine, ropivacaine, and one study used levobupivacaine.

Mastectomy

The body of evidence included 20 randomized clinical trials of patients scheduled for radical mastectomy under general anesthesia, where study subjects did not receive any regional anesthesia nor surgical site local anesthetic infiltration, comparing fascial plane blocks to controls and nine comparing paravertebral blocks to controls. Of the 20 trials assessing fascial plane blocks, postoperative pain management consisted of opioids only in 9 trials,^{66,67,69,71–73,75,79,82} opioids with at least one or more nonopioid analgesics such as acetaminophen, NSAIDs, and COX-2 inhibitors in 10 trials,^{68,70,74,76–78,80,81,83,85} and one trial did not specify analgesics administered postoperatively.⁸⁴ Of those assessing paravertebral blocks, postoperative pain management consisted of opioids only in three,^{69,91,93} opioids with one or more nonopioid analgesic in five trials,^{74,89,90,92,94} and NSAIDs and acetaminophen in one.⁸⁸

Fascial plane blocks included single-injection erector spinae plane, interpectoral plane, pector serratus plane, and serratus anterior plane. Nine studies compared single-injection paravertebral block to controls. Local anesthetics administered were bupivacaine or ropivacaine in both block groups.

Minimally Invasive Cardiothoracic Surgeries

The body of evidence for minimally invasive cardiothoracic surgeries included 43 randomized clinical trials, 20 of which assessed the effectiveness of single-injection fascial plane blocks, and nine assessed continuous fascial plane blocks.^{22,105,123–130} Five trials compared controls to continuous epidural analgesia,^{131–135} six trials compared single-injection paravertebral block,^{137–142} and three assessed continuous paravertebral blocks to controls.^{143–145}

Minimally invasive cardiothoracic surgeries include video-assisted thoracic surgery (VATS), lobectomy, valve repair/replacement, and esophageal under general anesthesia. Fascial plane blocks included erector spinae plane, intercostal, and serratus anterior plane.²² Local anesthetics administered were bupivacaine or ropivacaine.

Minimally Invasive Abdominal Surgeries

Minimally invasive abdominal surgeries were grouped based on incision site and pain intensity. The body of evidence included 62 randomized clinical trials of patients scheduled for minimally invasive abdominal surgeries mainly cholecystectomy (34%), colorectal (19%), hysterectomy (10%), and gastrectomy (7%) under general or regional anesthesia comparing fascial plane blocks to controls. Surgical subgroups included 6 trials in nephrectomy and urologic surgeries,^{156,165,174,187,205,209} 23 trials involving appendectomy, bariatric surgery, and cholecystectomy,^{54,150–152,154,158–160,166,169,170,175,177,178,183–185,193,196,197,199,201,202} 20 studies in colorectal and gynecologic surgeries,^{153,155,163,164,167,168,171,173,181,188,190–192,194,195,198,200,203,206,207} 9 in gastrectomy and liver resection,^{149,157,162,172,176,179,186,204,208} and 4 in hernia repair.^{161,180,182,189}

Fascial plane blocks included erector spinae plane, quadratus lumborum, rectus sheath, serratus anterior plane, and transversus abdominis plane. Local anesthetics administered were bupivacaine, ropivacaine, or levobupivacaine.

Pediatric Studies

Given the paucity of evidence assessing regional analgesia techniques in infants and children, we included nine randomized clinical trials with fewer than sixty patients and performed pooled analyses when the evidence base included at least two trials. The evidence was pooled from nine randomized clinical trials including infants and children undergoing open cardiac surgery^{218–226} and two randomized clinical trials for open hernia repair^{228,229} comparing fascial plane blocks to controls. All trials utilized

opioids for perioperative pain management with or without nonopioid analgesics.

Cardiac surgeries included septal defect repair *via* median open sternotomy. Fascial plane blocks included erector spinae plane, intercostal plane, interpectoral plane, pector serratus plane, quadratus lumborum, retrolaminar, serratus anterior plane, and transversalis fascia plane. Local anesthetics administered were bupivacaine or ropivacaine.

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Competing Interests

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Correspondence

Address correspondence to Dr. Domino: Box 356540, University of Washington, Seattle, Washington 98195. kdomino@uw.edu

Supplemental Digital Content

Supplemental digital file 1. Protocol, <https://links.lww.com/ALN/E266>

Supplemental digital file 2. Search strategy, <https://links.lww.com/ALN/E267>

Supplemental digital file 3. PRISMA flowchart, <https://links.lww.com/ALN/E268>
 Supplemental digital file 4. Methodology, <https://links.lww.com/ALN/E269>
 Supplemental digital file 5. Risk of bias ratings, <https://links.lww.com/ALN/E270>
 Supplemental digital file 6. Supporting evidence, <https://links.lww.com/ALN/E271>
 Supplemental digital file 7. Supporting evidence for block versus block, <https://links.lww.com/ALN/E272>

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