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Guidelines on the Management of Postoperative Pain

Management of Postoperative Pain: A Clinical Practice Guideline From the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council

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Abstract: **Most patients who undergo surgical procedures experience acute postoperative pain, but evidence suggests that less than half report adequate postoperative pain relief. Many preoperative, intraoperative, and postoperative interventions and management strategies are available for reducing and managing postoperative pain. The American Pain Society, with input from the American Society of Anesthesiologists, commissioned an interdisciplinary expert panel to develop a clinical practice guideline to promote evidence-based, effective, and safer postoperative pain management in children and adults. The guideline was subsequently approved by the American Society for Regional Anesthesia. As part of the guideline development process, a systematic review was commissioned on various aspects related to various interventions and management strategies for postoperative pain. After a review of the evidence, the expert panel formulated recommendations that addressed various aspects of postoperative pain management, including preoperative education, perioperative pain management planning, use of different pharmacological and nonpharmacological modalities, organizational policies, and transition to outpatient care. The recommendations are based on the underlying premise that optimal management begins in the preoperative period with an assessment of the patient and development of a plan of care tailored to the individual and the surgical procedure involved. The panel found that evidence supports the use of multimodal regimens in many situations, although the exact components of effective multimodal care will vary depending on the patient, setting, and surgical procedure. Although these guidelines are based on a systematic review of the evidence on management of postoperative pain, the panel identified numerous research gaps. Of 32 recommendations, 4 were assessed as being supported by high-quality evidence, and 11 (in the areas of patient education and perioperative planning, patient assessment, organizational structures and policies, and transitioning to outpatient care) were made on the basis of low-quality evidence.**

Perspective: ***This guideline, on the basis of a systematic review of the evidence on postoperative pain management, provides recommendations developed by a multidisciplinary expert panel. Safe and effective postoperative pain management should be on the basis of a plan of care tailored to the individual and the surgical procedure involved, and multimodal regimens are recommended in many situations.***

Key words: *Postoperative pain management, clinical practice guidelines, analgesia, education, multimodal therapy, patient assessment, regional analgesia, neuraxial analgesia.*

More than 80% of patients who undergo surgical procedures experience acute postoperative pain and approximately 75% of those with postoperative pain report the severity as moderate, severe, or extreme.[12,96] Evidence suggests that less than half of patients who undergo surgery report adequate postoperative pain relief.[12] Inadequately controlled pain negatively affects quality of life, function, and functional recovery, the risk of post-surgical complications, and the risk of persistent postsurgical pain.[165]

Many preoperative, intraoperative, and postoperative interventions and management strategies are available and continue to evolve for reducing and managing postoperative pain. The American Pain Society (APS), with input from the American Society of Anesthesiologists (ASA), commissioned a guideline on management of postoperative pain to promote evidence-based, effective, and safer postoperative pain management in children and adults, addressing areas that include preoperative education, perioperative pain management planning, use of different pharmacological and nonpharmacological modalities, organizational policies and procedures, and transition to outpatient care. The ASA published a practice guideline for acute pain management in the perioperative setting in 2012[6]; the APS has not previously published guidelines on management of postoperative pain. After completion, the guideline was also reviewed for approval by the American Society of Regional Anesthesia and Pain Medicine.

Methods

Panel Composition

The APS, with input from the ASA, convened a panel of 23 members with expertise in anesthesia and/or pain medicine, surgery, obstetrics and gynecology, pediatrics, hospital medicine, nursing, primary care, physical therapy, and psychology to review the evidence and formulate recommendations on management of postoperative pain (see Supplementary Appendix 1 for a list of panel members). Three cochairs (D.B.G. [selected by the APS], O.d.L.-C. [selected by the ASA], and J.M.R.) were selected to lead the panel, which also included the APS Director of Clinical Guidelines Development (R.C.).

Target Audience and Scope

The intent of the guideline is to provide evidence-based recommendations for management of postoperative pain. The target audience is all clinicians who manage postoperative pain. Management of chronic pain, acute nonsurgical pain, dental pain, trauma pain, and periprocedural (nonsurgical) pain are outside the scope of this guideline.

Evidence Review

This guideline is informed by an evidence review conducted at the Oregon Evidence-Based Practice Center

and commissioned by APS.[51] With the Oregon Evidence-Based Practice Center, the panel developed the key questions, scope, and inclusion criteria used to guide the evidence review. Literature searches were conducted through November 2012. The full search strategy, including the search terms and databases searches, is available in the evidence review. Investigators reviewed 6556 abstracts from searches for systematic reviews and primary studies from multiple electronic databases, reference lists of relevant articles, and suggestions from expert reviewers. A total of 107 systematic reviews and 858 primary studies (not included in previously published systematic reviews) were included in the evidence report.[51] Updated searches were conducted through December 2015. New evidence was reviewed and judged to be consistent with the recommendations in this guideline, which was updated with new citations as relevant.

Grading of the Evidence and Recommendations

The panel used methods adapted from the Grading of Recommendations Assessment, Development, and Evaluation Working Group to rate the recommendations included in this guideline.[118] Each recommendation received a separate grade for the strength of the recommendation (strong or weak) and for the quality of evidence (high, moderate, or poor) (Supplementary Appendix 2). In general, a strong recommendation is on the basis of the panel's assessment that the potential benefits of following the recommendation clearly outweigh potential harms and burdens. In light of the available evidence, most clinicians and patients would choose to follow a strong recommendation. A weak recommendation is on the basis of the panel's assessment that benefits of following the recommendation outweigh potential harms and burdens, but the balance of benefits to harms or burdens is smaller or evidence is weaker. Decisions to follow a weak recommendation could vary depending on specific clinical circumstances or patient preferences and values. For grading the quality of a body of evidence that supports a recommendation, we considered the type, number, size, and quality of studies; strength of associations or effects; and consistency of results among studies.[118]

Guideline Development Process

The guideline panel met in person in August 2009 and January 2011. At the first meeting, the panel developed the scope and key questions used to guide the systematic evidence review. At the second meeting, the panel reviewed the results of the evidence review and drafted initial potential recommendation statements. After the second meeting, additional draft recommendation statements were proposed. The panelists then participated in a multistage Delphi process, in which each draft recommendation was ranked and revised. At each stage of the Delphi process, the lowest-ranked recommendations were eliminated. A two-thirds majority was required for a recommendation to be approved, although unanimous or near-unanimous consensus was achieved for all recommendations. Persons who had conflicts of interest were recused from voting on recommendations potentially affected by the conflicts. After finalization of the recommendations, the guideline was written by panel subgroups and drafts distributed to the panel for feedback and revisions. More than 20 external peer reviewers were solicited for additional comments on the draft guideline. After another round of revisions and panel approval, the guideline was submitted to the APS and ASA for approval. The guideline was approved by the APS Board of Directors in April 2015 and by the ASA's Committee on Regional Anesthesia, Executive Committee, and Administrative Council in October 2015. It was also approved by the American Society of Regional Anesthesia Board of Directors in August 2015.

The APS intends to update this guideline and the evidence report used to develop it by 2021, or earlier if critical new evidence becomes available. Recommendations that do not specifically state that they are for adults or children are general recommendations across age groups.

Recommendations

Preoperative Education and Perioperative Pain Management Planning

Recommendation 1

- The panel recommends that clinicians provide patient and family-centered, individually tailored education to the patient (and/or responsible caregiver), including information on treatment options for management of postoperative pain, and document the plan and goals for postoperative pain management (strong recommendation, low-quality evidence).

Individually tailored programs of education and support for patients with more intensive needs (eg, due to medical or psychological comorbidities or social factors) who undergo surgery are associated with beneficial effects including reduced postoperative opioid consumption,[73,172] less preoperative anxiety,[9,42,57,69] fewer requests for sedative medications,[172] and reduced length of stay after surgery.[15,57,73,308] Although studies of patients without more intensive needs did not clearly show beneficial clinical effects of preoperative educational interventions, the panel believes such interventions remain of value for helping to inform patients regarding perioperative treatment options and to engage them in the decision-making process. Educational interventions can range from single episodes of face-to-face instruction or provision of written materials, videos, audiotapes, or Web-based educational information to more intensive, multicomponent preoperative interventions including individualized and supervised exercise, education, and telephone calls. There is insufficient evidence to determine the comparative effectiveness of different educational interventions or to recommend specific interventions, but the diversity

of clinical situations, patient needs, and patient preferences support the need for an individualized approach. Such an individualized approach to preoperative education includes provision of information that is "age-appropriate, geared to the person's and family's level of comprehension and general health literacy, cultural and linguistic competency, and supported by timely opportunities to ask questions and receive authoritative and useful answers."[56]

Although the optimal timing and content of preoperative education is uncertain, the panel suggests that preoperative education routinely include information regarding indicated changes in use of analgesics before surgery (eg, discontinuation of aspirin for procedures in which hemorrhage would present high risks or in patients at high risk of hemorrhage) and continuation of medications (eg, opioids, benzodiazepines, gabapentinoids, or baclofen) to avoid a withdrawal syndrome, unless there is a specific plan to taper. Although use of opioids before surgery is associated with greater postoperative analgesic requirements,[221] there is insufficient evidence to recommend routinely decreasing opioid doses or discontinuing opioids before surgery. Patients receiving long-term opioid therapy before surgery might benefit from routine use of nonopioid adjuvant medications that might reduce postoperative opioids requirements (see Recommendation 30). Education or counseling should also include information about how pain is reported and assessed (including use of pain assessment tools), when to report pain, individualized options for perioperative pain management (in many cases including a multimodal pharmacologic and nonpharmacologic approach), and realistic goals for pain control. When certain cognitive modalities are planned, preoperative training of patients can enhance effectiveness (see Recommendation 9). Education should also aim to correct any underlying misperceptions about pain and analgesics (eg, beliefs that pain after surgery does not warrant treatment, that health care providers will only respond to extreme expressions of pain, that opioids are always required for postoperative pain, or that opioid use inevitably leads to addiction).[56] Pregnant women who undergo surgery should be informed about potential effects of treatment options on the fetus and newborn, including effects of in utero and breastfeeding exposure to opioids or other medications for management of postoperative pain.[148]

Recommendation 2

- The panel recommends that the parents (or other adult caregivers) of children who undergo surgery receive instruction in developmentally-appropriate methods for assessing pain as well as counseling on appropriate administration of analgesics and modalities (strong recommendation, low-quality evidence).

The panel recommends that clinicians provide developmentally appropriate information to children and their parents, to better inform and engage them in care. Research showing effectiveness of preoperative child or parental educational interventions on postoperative clinical outcomes in children who undergo surgery is limited.[46,143,258] However, preoperative education might help address parental barriers to appropriate management of postoperative pediatric pain, such as uncertainty regarding how to evaluate pain and reluctance to use pain medication because of fears of addiction, although more research is needed to understand optimal methods of preoperative parental education.[159,160] Reduction of parental anxiety regarding postoperative pain might be associated with decreased reports of pain and pain behaviors in children, perhaps mediated in part by changes in how analgesics are administered by the parents.[121] Suggested components of education include parental preparation for what to expect regarding the child's postoperative course and information on how to help children cope with perioperative pain.[143,200]

Studies on the accuracy and usefulness of parents' assessment of children's pain are mixed. Although some studies indicate better correlation between parent and child pain ratings than those of health care providers and children, other studies indicate that parents frequently under- or overestimate their child's postsurgical pain.[49,121,143,159,264] Therefore, although the panel recommends that parents receive education on methods for assessing postoperative pain in children, there is insufficient evidence to recommend a specific method. Better validation of pain assessment tools for parents to assess their children's pain and evaluations of the usefulness of explicit written instructions to supplement verbal discharge directions would help to better inform optimal methods for providing postdischarge pain management in children.[88,160]

Recommendation 3

- The panel recommends that clinicians conduct a preoperative evaluation including assessment of medical and psychiatric comorbidities, concomitant medications, history of chronic pain, substance abuse, and previous postoperative treatment regimens and responses, to guide the perioperative pain management plan (strong recommendation, low-quality evidence).

Clinicians should perform a thorough history and physical examination to develop an individually tailored pain management plan through a shared decision-making approach. The pain management plan should be on the basis of evidence regarding effective interventions for the specific surgery or surgical site in question, modified by factors unique to the patient, including previous experiences with surgery and postoperative treatment, medication allergies and intolerances, cognitive status, comorbidities, preferences for treatment, and treatment goals. Research in other areas of pain and health care indicates that patients engaged in collaborative care including shared decision-making with their providers experience better health outcomes.[70,133]

Although no study has specifically evaluated the usefulness of individual components of the preoperative

history and physical, an assessment of past and current history of pain (including the use of, response to, and preferences regarding analgesics), and presence of medical comorbidities (eg, bleeding disorders or previous spinal surgery are relative contraindications to the use of epidural or spinal techniques) and psychiatric comorbidities (eg, anxiety, depression, and maladaptive coping behaviors such as catastrophizing) are critical for developing an appropriate postoperative pain management plan. It is also important to assess for a history of physical dependence or tolerance to opioids and previous or current substance use disorder because their presence might be associated with increased opioid requirements and delayed recovery in the postoperative period,[221] and to assess for risk factors for opioid misuse, which might affect medication choices, follow-up, monitoring, and tapering protocols. In addition to use of opioids, the history should also attempt to identify in a nonjudgmental manner use and abuse of benzodiazepines, cocaine, alcohol, and other psychoactive substances that might affect pain management.

Recommendation 4

- The panel recommends that clinicians adjust the pain management plan on the basis of adequacy of pain relief and presence of adverse events (strong recommendation, low-quality evidence).

Provision of optimal pain management requires ongoing reassessments to determine the adequacy of pain relief, detect adverse events early, and help monitor progress toward functional goals. Clinicians should be prepared to adjust the pain management plan postoperatively when pain relief is inadequate or to address or avert adverse events. For example, some patients might develop respiratory depression requiring rapid reduction of opioids and close monitoring, or other measures depending on the urgency of the situation. Individual differences in response to analgesics and other interventions are well recognized and support an individualized and flexible approach to pain management.[5,108]

Methods of Assessment

Recommendation 5

- The panel recommends that clinicians use a validated pain assessment tool to track responses to postoperative pain treatments and adjust treatment plans accordingly (strong recommendation, low-quality evidence).

Pain assessment and reassessment are required to provide optimal postoperative pain care. Pain assessment helps determine whether pain management is adequate, whether analgesic or analgesic dose changes are required, whether changes in the postoperative pain management plan or additional interventions are warranted, and in the case of difficult to manage pain whether specialty consultation or other measures are needed. Because pain is inherently subjective, patient self-report is the primary basis of all pain assessments.[5,293] For patients who cannot adequately report their pain because of cognitive deficits, sedation, developmental stage, or other factors, clinicians might need to use behavioral assessment tools and solicit input from caregivers to assess pain.[129] In all cases, clinicians should not rely solely on "objective" measures such as pain-related behaviors or vital signs in lieu of patient self-report to determine the presence of or intensity of pain because such measures are neither valid nor reliable. At similar levels of pain, pain behaviors might vary markedly between individuals. Therefore, although assessments of pain behaviors might supplement information from self-reported pain, it is important to interpret behavioral observations cautiously.

A number of pain assessment tools have been validated for accuracy in detecting the presence of and quantifying the severity of pain, and have been tested for intrapatient and inter-rater reliability (Table 1).[28,30,41,43,45,100,131,137,140,185,195,197,202,224,225,234,254,276,280,295,297,309] Validated pain assessment tools use different methods to measure pain, including visual analogue scales, numeric or verbal rating scales, symbols, and others. The panel recommends that clinicians use a validated pain assessment tool, although there is inadequate evidence on the effects of different pain assessment tools on postoperative pain outcomes to guide recommendations on which specific tools to use. Therefore, the selection of a particular pain assessment tool should be on the basis of factors such as developmental status, cognitive status, level of consciousness, educational level, and cultural and language differences. In children, the Pediatric Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials group suggests the use of the Face, Legs, Arms, Cry, Consolability and Parents Post-operative Pain Measure for assessing acute pain in preverbal and nonverbal children[298] on the basis of the reliability, validity, and ease of use. Tools that have been developed for use in the intensive care unit setting include the Behavioral Pain Scale and the Critical-Care Pain Observation Tool.[3,98]

Table 1. Examples of Validated Pain Intensity Assessment Scales

Name of Scale	*Rating System*
NRSs	Six-point NRS (NRS 0-5)[207]
	Eleven-point NRS (NRS 0-10)[24,25,53,95]
	Twenty-one point NRS (NRS 0-20)[50,131,281]
VRS	Four-point VRS[53]
	Seven-point Graphic Rating Scale[24,25]
	Six-point Present Pain Inventory (PPI)[94,95,157,201,223]
Visual Analogue Scales	Commonly rated 0 to 10 cm or 0 to 100 mm.
Pain Thermometer	Combines a visual thermometer with verbal descriptions of pain[130,131]
Faces Rating Scales	Faces Pain Scale-Revised[31,53,83,93,131,157,273,281]
	Wong-Baker FACES pain rating scale[309,314]
	Oucher scale[27,29]

Abbreviations: NRS, Numeric Rating Scale; VRS, Verbal Rating Scale.

Table 2. Suggested Elements of Postoperative Pain Assessment

Element	Questions Used for Assessment
1. Onset and pattern	When did the pain start? How often does it occur? Has its intensity changed?
2. Location	Where is the pain? Is it local to the incisional site, referred, or elsewhere?
3. Quality of pain	What does the pain feel like?
4. Intensity	How severe is the pain? (See Table 1)
5. Aggravating and relieving factors	What makes the pain better or worse?
6. Previous treatment	What types of treatment have been effective or ineffective in the past to relieve the pain?
7. Effect	How does the pain affect physical function, emotional distress, and sleep?
8. Barriers to pain assessment	What factors might affect accuracy or reliability of pain assessments[128] (eg, cultural or language barriers, cognitive barriers, misconceptions about interventions)?

Pain assessment involves more than just quantifying the intensity of pain. High pain intensity ratings or behavioral scale scores that do not respond to usual care should be investigated to determine whether the pain might be due to a new medical issue or surgical complication and the potential role of opioid tolerance and psychological distress. Assessment should determine what interventions have been effective for the pain, how the pain affects function, the type of pain (eg, neuropathic, visceral, somatic, muscle spasms), and whether there are barriers to effective pain management, such as cultural or language differences, cognitive deficits, or patient misconceptions about pain management (Table 2). In addition, it is not sufficient to assess pain only at rest. Pain that is relatively well controlled at rest can be severe during movement or with specific activities that cause increased pain (eg, swallowing after tonsillectomy), with important implications for symptom management and recovery. The panel suggests that clinicians assess pain at rest and with activities, as the latter is often more severe and difficult to control than pain at rest.[110,270] Presence of pain with activity has important implications for use of additional interventions and discharge planning. For example, pain that is well controlled at rest but severe with movement can have major effects on a patient's ability to participate in postsurgical rehabilitation and return to normal function, and pain with swallowing after tonsillectomy could increase risk for dehydration. Assessments for other clinical issues such as sedation, delirium, and nausea or other side effects related to interventions are also important to help guide decisions regarding adjustment of the postoperative pain management plan.

There is insufficient evidence to guide firm recommendations on optimal timing or frequency of patient reassessments in the postoperative setting. The timing of assessments after administration of an intervention should be informed by the time to achieve peak effects, which is typically 15 to 30 minutes after parenteral drug therapy or 1 to 2 hours after administration of an oral analgesic. With nonpharmacologic interventions, pain relief often occurs during or immediately after their application. The optimal frequency of reassessment is likely to depend on a number of factors, including the type of surgical procedure, the adequacy of initial pain relief, the presence of side effects, presence of comorbidities, and changes in clinical status. Reassessments might be performed less frequently for patients with more stable pain (eg, patients who have exhibited good pain control without side effects after 24 hours of stable therapy). Pain reassessments might be useful at the time of nursing shift changes or with new caregivers to establish a baseline and promote continuity of care, although evidence showing that routine reassessment of pain at nursing shift changes is associated with improved clinical outcomes is not available.

General Principles Regarding the Use of Multimodal Therapies

Recommendation 6

- The panel recommends that clinicians offer multimodal analgesia, or the use of a variety of analgesic medications and techniques combined with nonpharmacological interventions, for the treatment of postoperative pain in children and adults (strong recommendation, high-quality evidence).

Multimodal analgesia, defined as the use of a variety of analgesic medication and techniques that target different mechanisms of action in the peripheral and/or central nervous system (which might also be combined with nonpharmacological interventions) might have additive or synergistic effects and more effective pain relief compared with single-modality interventions. For example, clinicians might offer local anesthetic-based regional (peripheral and neuraxial) analgesic techniques in combination with systemic opioids and other analgesics as part of a multimodal approach to perioperative pain. Because of the availability of effective nonopioid analgesics and nonpharmacologic therapies for postoperative pain management, the panel suggests that clinicians routinely incorporate around the clock nonopioid analgesics and nonpharmacologic therapies into multimodal analgesia regimens. Systemic opioids might not be required in all patients. One study suggests that it should be avoided when not needed, because limited evidence suggests that perioperative opioid therapy might be associated with increased likelihood of long-term opioid use, with its attendant risks.[4]

Randomized trials[76,194] have shown that multimodal analgesia involving simultaneous use of combinations of several medications acting at different receptors or 1 or

more medications administered through different techniques (eg, systemically and neuraxially) is associated with superior pain relief and decreased opioid consumption compared with use of a single medication administered through 1 technique, even after excluding trials that were retracted because of scientific fraud or were not retracted but authored by an investigator who admitted to fraud in other work.[238,260] The addition of nonpharmacological interventions might result in additional effects consistent with the biopsychosocial model of pain. For any given situation, a number of potential multimodal combinations are possible, and different multimodal regimens might be appropriate, depending on the specific surgery, individual clinical factors, and patient preferences. Subsequent sections of this guideline provide more specific recommendations on the different components of multimodal analgesia. In general, the use of local anesthetic-based regional anesthesia techniques for surgical procedures of the extremities, abdomen, and thorax is encouraged, because of the multiple trials that showed their effectiveness in combination with systemic analgesics (see Recommendation 23). Selection of multimodal therapies is a challenge because for each surgical procedure, many potential multimodal therapy combinations are possible, but relatively few have been evaluated in rigorous trials. On the basis of the available evidence and panel consensus, the options for components of multimodal therapy for several commonly performed surgeries are summarized in Table 3. Techniques not typically used together are intra-articular, peripheral regional, and neuraxial techniques.

When using multimodal analgesia, clinicians should be aware of the different side effect profile for each analgesic medication or technique used, and provide appropriate monitoring to identify and manage adverse events. Studies varied in showing whether multimodal approaches were associated with a decreased risk of adverse events than single-modality approaches, depending in part on the specific regimens and comparisons evaluated.[194]

Use of Physical Modalities

Recommendations 7 and 8

- The panel recommends that clinicians consider transcutaneous electrical nerve stimulation (TENS) as an adjunct to other postoperative pain treatments (weak recommendation, moderate-quality evidence).
- The panel can neither recommend nor discourage acupuncture, massage, or cold therapy as adjuncts to other postoperative pain treatments (insufficient evidence).

Physical modalities include transcutaneous TENS, acupuncture and related interventions, massage, cold therapy (with and without compression), localized heat, warm insufflation, continuous passive motion, and immobilization or bracing. Although these therapies are generally considered to be safe, evidence on their effectiveness as adjunctive therapies as part of a multimodal approach to perioperative pain management varies substantially.

TENS are small portable devices that deliver low-voltage electrical currents through the skin. TENS is thought to activate endogenous descending inhibitory pathways activating opioid receptors to produce reduced central excitability and reduce pain through stimulatory effects on large diameter afferent fibers.[266] A fair-quality systematic review of >20 randomized trials found use of TENS associated with approximately 25% less postoperative analgesic use compared with no TENS.[32] Therefore, the panel recommends clinicians consider use of TENS as an adjunct to other postoperative pain management treatments. There is insufficient evidence to recommend specific TENS regimens, although effects appear stronger in trials in which TENS was applied using optimal predefined parameters for the stimulation.[23,102,122,132,151,179,267,300] Studies of TENS most commonly evaluated its effectiveness when applied near the surgical incision area, although in some studies TENS was applied to acupoints away from the incision, with similar effects.

Acupuncture involves the placement of needles into the body at defined acupuncture points. Related interventions that also involve stimulation of defined acupuncture points include acupressure (pressure rather than needles applied to acupuncture points), auricular acupuncture (acupuncture applied at the ear), electroacupuncture (electric current applied to needles placed at acupuncture points on the body), and others. Evidence on the effectiveness of needle acupuncture to the body for postoperative pain in adults is mixed, with some trials showing no beneficial effects on postoperative pain or analgesic use compared with sham acupuncture or analgesic use.[65,111,116,170,284,301] Evidence on acupressure,[85] auricular acupuncture,[291,292,313] and electroacupuncture in adults,[180,190,262,310] and needle acupuncture in children[302,316] is limited and does not clearly show beneficial effects in management of postoperative pain. Evidence on massage was limited, and also did not clearly demonstrate benefits for postoperative pain.[91,124,141,203,230,271]

Although other physical modalities are generally considered to be safe, lack of demonstrated effectiveness preclude recommendations supporting their use. Costs for equipment and care provider time should be considered in relationship to the low probability of patient benefit before initiating these therapies as adjuvants to other multimodal postoperative pain treatments.

Cold therapy refers to the superficial application of cold to the surface of the skin, with or without compression and with or without a mechanical recirculating device to maintain cold temperatures. Localized cold therapy has commonly been used in acute pain, including postoperative pain, with potential benefits at the site of injury thought to be related to reductions in tissue temperature, resulting in reduced edema and local analgesia. Trials of cold therapy were inconsistent and frequently found no

Table 3. Options for Components of Multimodal Therapy for Commonly Performed Surgeries

Type of Surgery	Systemic Pharmacologic Therapy	Local, Intra-articular or Topical Techniques*	Regional Anesthetic Techniques*	Neuraxial Anesthetic Techniques*	Nonpharmacologic Therapies†
Thoracotomy	Opioids‡ NSAIDs§ and/or acetaminophen Gabapentin or pregabalin§ i.v. ketamine¶		Paravertebral block	Epidural with local anesthetic (with or without opioid), or intrathecal opioid	Cognitive modalities TENS
Open laparotomy	Opioids‡ NSAIDs§ and/or acetaminophen Gabapentin or pregabalin§ i.v. ketamine¶ i.v. lidocaine	Local anesthetic at incision i.v. lidocaine infusion	Transversus abdominis plane block	Epidural with local anesthetic (with or without opioid), or intrathecal opioid	Cognitive modalities TENS
Total hip replacement	Opioids‡ NSAIDs§ and/or acetaminophen Gabapentin or pregabalin§ i.v. ketamine¶	Intra-articular local anesthetic and/or opioid	Site-specific regional anesthetic technique with local anesthetic	Epidural with local anesthetic (with or without opioid), or intrathecal opioid	Cognitive modalities TENS
Total knee replacement	Opioids‡ NSAIDs§ and/or acetaminophen Gabapentin or pregabalin§ i.v. ketamine¶	Intra-articular local anesthetic and/or opioid	Site-specific regional anesthetic technique with local anesthetic	Epidural with local anesthetic (with or without opioid), or intrathecal opioid	Cognitive modalities TENS
Spinal fusion	Opioids‡ Acetaminophen† Gabapentin or pregabalin§ i.v. ketamine¶	Local anesthetic at incision		Epidural with local anesthetic (with or without opioid), or intrathecal opioid	Cognitive modalities TENS
Cesarean section	Opioids‡ NSAIDs§ and/or acetaminophen	Local anesthetic at incision	Transversus abdominal plane block	Epidural with local anesthetic (with or without opioid), or intrathecal opioid	Cognitive modalities TENS
CABG	Opioids‡ Acetaminophen Gabapentin or pregabalin§ i.v. ketamine¶				Cognitive modalities TENS

Abbreviation: CABG, coronary artery bypass grafting.
NOTE. Blank cells indicate techniques generally not used for the procedure in question.
*Intra-articular, peripheral regional, and neuraxial techniques typically not used together.
†Use as adjunctive treatments.
‡Use i.v. PCA when parenteral route needed for more than a few hours and patients have adequate cognitive function to understand the device and safety limitations.
§May be administered preoperatively.
¶On the basis of panel consensus, primarily consider for use in opioid-tolerant or otherwise complex patients.

differences compared with no cold therapy in postoperative pain or analgesic use.[8,20,26,38,54,61,67,72,87,101,125,136,168,169,176,214,236,253,255,269,299,306,311] Similarly, there is no clear evidence of beneficial effects from immobilization, bracing,[312] or continuous passive motion.[55,235,299] Evidence on warm insufflation of the abdominal cavity[251] was limited and insufficient to guide recommendations.

Use of Cognitive–Behavioral Modalities

Recommendation 9

- The panel recommends that clinicians consider the use of cognitive–behavioral modalities in adults as part of a multimodal approach (weak recommendation, moderate-quality evidence).

A number of cognitive–behavioral modalities have been evaluated as adjunctive treatments in patients who undergo surgery. These include guided imagery[11,58,119,174,186,229,286,287] and other relaxation methods,[44,60,86,89,106,107,119,204,229,256,304,305,308] hypnosis,[16,79,80,112,123,152,206,277] and intraoperative suggestions[33,34,36,82,150,181,196] (which involve positive suggestions to patients, usually under anesthesia, about the patient's ability to manage and cope with postoperative pain and recovery from surgery). Music has been evaluated as a part of multicomponent relaxation interventions, or as a separate intervention.[71,106,107,126,145,174,192,210,211,241,259,263,282,285,319] Cognitive–behavioral modalities can be provided to patients by a variety of practitioners, including psychologists, psychotherapists, nurses, physicians, social workers, and child life specialists.

Most studies of cognitive–behavioral modalities showed some positive effects on postoperative pain, analgesic use, or anxiety, with inconsistent or unclear effects on duration of hospitalization. In general, cognitive–behavioral modalities are noninvasive, and do not appear to be associated with significant harm. Although studies of cognitive–behavioral modalities have primarily been conducted in adults, a small number of studies of guided imagery and music have been conducted in children.[142,156,171,187,188] Results have been inconsistent in terms of showing benefit on outcomes related to postoperative pain, with studies reporting limited detail on how interventions addressed specific developmental considerations in children.

The panel recommends that clinicians consider the use of cognitive–behavioral modalities as part of a multimodal approach in adults. There is insufficient evidence to recommend one specific cognitive–behavioral modality over another, or to recommend specific techniques. Some of these techniques, such as guided imagery and some relaxation methods, appear to require patient engagement in preoperative training for optimal results. A number of relaxation methods are available and it is uncertain which method is most effective, or whether the relaxation intervention is more effective if started before rather than after surgery. There is insufficient evidence to recommend for or against cognitive–behavioral modalities in children. When considering use of cognitive–behavioral modalities, clinicians should discuss their use with patients and families as part of an overall perioperative management plan.

Use of Systemic Pharmacological Therapies

Recommendation 10

- The panel recommends oral over intravenous (i.v.) administration of opioids for postoperative analgesia in patients who can use the oral route (strong recommendation, moderate quality evidence).

Most evidence suggests that i.v. administration of opioids is not superior for postoperative analgesia compared with oral administration.[245,268] Therefore, oral administration of opioids is generally preferred for management of postoperative pain in patients who can use the oral route. Postoperative pain is often continuous initially and often requires round-the-clock dosing during the first 24 hours. Long-acting oral opioids are generally not recommended or labeled for use in the immediate postoperative period[289] because of the need to titrate doses and the lack of evidence showing superiority over short-acting oral opioids, with the possible exception of patients who receive long-acting opioids before surgery.

Preoperative administration of opioids is not recommended as an intervention to decrease postoperative pain and/or opioid consumption, because studies show no clear benefit from this practice.[215] Clinicians should counsel patients to continue regularly prescribed opioids during the preoperative period unless there is a plan to taper or discontinue opioids.

Recommendation 11

- The panel recommends that clinicians avoid using the intramuscular route for the administration of analgesics for management of postoperative pain (strong recommendation, moderate-quality evidence).

The use of the intramuscular route for the administration of analgesics for management of postoperative pain is discouraged because intramuscular administration can cause significant pain and is associated with unreliable absorption, resulting in inconsistent postoperative analgesia. The intramuscular route also has no clearly shown advantages over other routes (eg, oral, i.v., rectal, or topical) of medication administration.[268,283]

Recommendation 12

- The panel recommends that i.v. patient-controlled analgesia (PCA) be used for postoperative systemic analgesia when the parenteral route is needed (strong recommendation, moderate-quality evidence).

When postoperative parenteral administration of analgesics is necessary in hospitalized patients because of ileus, aspiration risk, or after surgical procedures that affect the ability to take medications orally or enterally,

the panel recommends the use of i.v. PCA. Patients appropriate for i.v. PCA are those who will require analgesia for more than a few hours and have adequate cognitive function to understand the device and its safety limitations. Research indicates that developmentally appropriate children as young as 6 years are able to use i.v. PCA appropriately.[246,252] On the basis of evidence showing greater effectiveness and patient satisfaction,[139] i.v. PCA is recommended over health care provider–initiated intermittent bolus dosing of opioids in adults. Administration by proxy should be avoided in adults, particularly when patients are sleeping, although limited evidence suggests that it can be done safely in children.[10,205] I.v. boluses of opioids might be considered in the immediate (first several hours) postoperative period for more rapid pain relief and analgesic titration, and in patients with postoperative sedation who are closely monitored.[215]

Recommendation 13

- The panel recommends against routine basal infusion of opioids with i.v. PCA in opioid-naive adults (strong recommendation, moderate-quality evidence).

In patients who receive i.v. PCA, the panel does not recommend the routine use of basal infusion of opioids in opioid-naive patients, because most evidence shows no improved analgesia compared with PCA without a basal infusion.[115,219,220,248] In addition, basal infusion of opioids is associated with an increased risk of nausea and vomiting, and in some studies with increased risk of respiratory depression in adults.[99] Evidence on the utility of basal infusion of opioids in opioid-tolerant patients who use PCA is lacking, but there might be a stronger rationale for its use because of the potential for underdosing and uncontrolled pain, as well as opioid withdrawal, particularly in patients who received long-term opioid therapy before surgery. There is insufficient evidence to guide recommendations on use of basal infusion of opioids in children, although some evidence suggests that a low basal rate can be used safely.[317]

Recommendation 14

- The panel recommends that clinicians provide appropriate monitoring of sedation, respiratory status, and other adverse events in patients who receive systemic opioids for postoperative analgesia (strong recommendation, low-quality evidence).

Because of the risk of excess sedation and respiratory depression, patients who receive systemic opioids for postoperative analgesia should be monitored closely in the initial hours after surgery or subsequent dose changes.[149] Such monitoring should include assessments of alertness and signs or symptoms of hypoventilation or hypoxia. Although pulse oximetry is frequently used to monitor respiratory status in the postoperative period, it is unclear whether pulse oximetry is superior to nurse observation of respiratory rate and mental status, because randomized trials show no clear effect on clinical outcomes[226] and pulse oximetry has low sensitivity for hypoventilation when supplemental oxygen is being administered. Limited evidence suggests that capnography might be more sensitive than pulse oximetry in identifying respiratory depression in patients receiving supplemental oxygen.[193] However, there is insufficient evidence to guide firm recommendations on the use of capnography or other more sophisticated methods for monitoring. Risk factors for respiratory depression include a history of obstructive or central sleep apnea[178,182] and use of other central nervous system depressant medications.[149] In patients with excess sedation or signs of respiratory depression, clinicians should be prepared to change or reduce the opioid medication, support respiratory effort, and administer opioid antagonists when necessary. Clinicians should also assess for other common side effects associated with opioids, such as postoperative nausea and vomiting and opioid-induced constipation, which might be dose-limiting or require dose reductions if unresponsive to bowel regimens.

Recommendation 15

- The panel recommends that clinicians provide adults and children with acetaminophen and/or nonsteroidal anti-inflammatory drugs (NSAIDs) as part of multimodal analgesia for management of postoperative pain in patients without contraindications (strong recommendation, high-quality evidence).

Acetaminophen and NSAIDs have been evaluated as part of multimodal analgesia in patients also receiving opioids for management of postoperative pain. Most studies show use of acetaminophen or NSAIDs in conjunction with opioids is associated with less postoperative pain or opioid consumption than opioids alone.[17,63,103,114,127,166,199] In addition, acetaminophen and NSAIDs have different mechanisms of action and research indicates that the combination of acetaminophen with NSAIDs might be more effective than either drug alone.[216] Most research indicates no clear differences between i.v. versus oral administration of acetaminophen or NSAIDs in reducing postoperative pain,[39,228,283] although onset of action might be faster with i.v. administration. NSAIDs are associated with increased risk of gastrointestinal bleeding and ulceration, cardiovascular events, and renal dysfunction that should be considered when selecting therapy; gastrointestinal risks are thought to be lower with the cyclooxygenase 2-selective NSAID celecoxib. Although animal studies suggest a link between bone nonunion after orthopedic surgeries and NSAID use, high-quality evidence on the effect of NSAIDs on nonunion rates after orthopedic surgical procedures is not available. Although some observational data suggest a possible association between high-dose NSAID use and nonunion in spinal fusion,[68,177] the association was not statistically significant in an analysis restricted to higher-quality studies,[68] and was not observed in children.[274] Observational studies suggest that NSAID use might be associated with increased risk of anastomotic leakage after colorectal surgery.[109,247,250] The panel found insufficient evidence to recommend against use of

NSAIDs in patients who undergo surgery for orthopedic fractures, spinal fusion, or colorectal surgery, but acknowledges the uncertainty about potential harms and that decisions be made after discussions with the surgeon, the patient, and consideration of alternatives. NSAIDs are contraindicated for management of perioperative pain in patients who undergo coronary artery bypass graft surgery because of an increased risk of cardiovascular events.[290]

Recommendation 16

- The panel recommends that clinicians consider giving a preoperative dose of oral celecoxib in adult patients without contraindications (strong recommendation, moderate-quality evidence).

The panel recommends that clinicians consider use of preoperative celecoxib in patients who undergo major surgery. Celecoxib is associated with reduced opioid requirements after surgery, and some studies reported lower postoperative pain scores.[74,138,146,161,239,275,303] The most common doses of celecoxib in the trials were 200 to 400 mg, administered 30 minutes to 1 hour preoperatively. Celecoxib is contraindicated in patients who undergo coronary artery bypass graft surgery, because of an increased risk of cardiovascular events.[290] The panel found insufficient evidence to recommend a preoperative dose of nonselective NSAIDs. No trial compared benefits or harms of nonselective NSAIDs versus celecoxib or placebo in patients who underwent nondental surgical procedures.

Recommendation 17

- The panel recommends that clinicians consider use of gabapentin or pregabalin as a component of multimodal analgesia (strong recommendation, moderate-quality evidence).

The panel recommends use of gabapentin or pregabalin as part of a multimodal regimen in patients who undergo surgery. Both medications are associated with reduced opioid requirements after major or minor surgical procedures, and some studies reported lower postoperative pain scores.[2,48,92,105,147,153,191,217,272,318] Both medications appear effective when administered as a preoperative dose (typical doses evaluated in trials were 600 or 1200 mg of gabapentin or 150 or 300 mg of pregabalin, administered 1–2 hours preoperatively), although some trials also found regimens that included postoperative dosing to be effective (typically gabapentin 600 mg as a single or in multiple doses and pregabalin 150 or 300 mg after 12 hours). The panel found insufficient evidence to determine optimal gabapentin and pregabalin doses; although higher doses might be more effective, they might also be associated with more sedation. Both drugs are only available in oral form, potentially limiting their use in the immediate postoperative period. The panel suggests that clinicians consider a preoperative dose of gabapentin or pregabalin, particularly in patients who undergo major surgery or other surgeries associated with substantial pain, or as part of multimodal therapy for highly opioid-tolerant patients. Potential adverse effects include dizziness and sedation that has not been linked to respiratory depression; dose reductions are recommended in patients with impaired renal function.

Although evidence on effectiveness of gabapentin or pregabalin in children is limited, some randomized trials found beneficial effects of preoperative gabapentin on postoperative pain and opioid use.[7,249]

Recommendation 18

- The panel recommends that clinicians consider i.v. ketamine as a component of multimodal analgesia in adults (weak recommendation, moderate-quality evidence).

I.v. ketamine has been evaluated as a part of multimodal analgesia. In adults and children, studies found i.v. ketamine infusions were associated with decreased postoperative pain medication use compared with placebo, and in some studies with decreased postoperative pain scores.[1,22,59,75,173,213] I.v. ketamine was also associated with decreased risk of persistent postsurgical pain.[198] In the trials, ketamine was administered preoperatively, intraoperatively, and/or postoperatively, at widely varying doses (ranging from boluses of .15–2 mg/kg before incision and at closure, with or without infusions ranging from .12 mg/kg/h [2 μg/kg/min] to 2 mg/kg/h). There was insufficient evidence to determine the optimal method for dosing ketamine, but the panel suggests using a preoperative bolus of .5 mg/kg followed by an infusion at 10 μg/kg/min intraoperatively, with or without a postoperative infusion at a lower dosage.[183] Ketamine was associated with increased risk of hallucinations and nightmares. Clinicians who administer ketamine should be familiar with its use and adverse effects, and the panel suggests that ketamine be reserved for major surgeries. Some situations in which ketamine might be particularly useful include management of highly opioid-tolerant patients[183] and patients who have difficulty tolerating opioids.

Recommendation 19

- The panel recommends that clinicians consider i.v. lidocaine infusions in adults who undergo open and laparoscopic abdominal surgery who do not have contraindications (weak recommendation, moderate-quality evidence).

I.v. lidocaine has been evaluated as a part of multimodal analgesia. In patients who underwent open or laparoscopic abdominal surgical procedures, studies showed perioperative or intraoperative i.v. lidocaine infusions were associated with shorter duration of ileus and better quality of analgesia compared with placebo.[189,296] In the trials, lidocaine was typically administered as a bolus (100–150 mg or 1.5–2.0 mg/kg) followed by an infusion of 2 to 3 mg/kg/h through the end of surgery. The panel found insufficient evidence to determine optimal dosing of lidocaine, but on the basis of clinical experience suggest an induction dose of 1.5 mg/kg followed by 2 mg/kg/h intraoperatively.[66,84] Continuation of lidocaine in the postoperative period has not been well studied.

Use of Local and/or Topical Pharmacological Therapies

Recommendation 20

- The panel recommends that clinicians consider surgical site–specific local anesthetic infiltration for surgical procedures with evidence indicating efficacy (weak recommendation, moderate-quality evidence).

The use of subcutaneous and/or intraarticular infiltration of long-acting local anesthetics at the surgical site has been shown to be effective as a component of multimodal analgesia in several surgical procedures, including total knee replacement, arthroscopic knee surgeries, cesarean section, laparotomy, and hemorrhoid surgery,[19,21,35,40,47,77,81,117,164,167,218,265] although some studies showed no benefit. Because evidence is somewhat mixed and because of the availability of alternative methods of postoperative analgesia, the panel does not recommend routine use of local anesthetic infiltration. Rather, use of local anesthetic infiltration should be on the basis of evidence showing benefit for the surgical procedure in question. Clinicians should be knowledgeable regarding specific local anesthetic infiltration techniques (including the use of extended-release formulations of local anesthetics such as liposomal bupivacaine),[62] which vary depending on the surgical procedure. In addition, although data are limited, continuous intra-articular bupivacaine in patients who undergo shoulder surgery might be associated with chondrolysis,[104,113,237] suggesting caution when considering this technique.

Recommendation 21

- The panel recommends that clinicians use topical local anesthetics in combination with nerve blocks before circumcision (strong recommendation, moderate-quality evidence).

In infants who undergo circumcision, evidence indicates effectiveness of topical anesthetics in combination with penile nerve block. Although studies indicate effectiveness of eutectic mixture of local anesthetics for this procedure, eutectic mixture of local anesthetics is associated with risk of methemoglobinemia in infants younger than 3 months of age, with excessive applications, or when using other drugs associated with methemoglobinemia.[175,278,279,288]

Recommendation 22

- The panel does not recommend intrapleural analgesia with local anesthetics for pain control after thoracic surgery (strong recommendation, moderate-quality evidence).

Intrapleural analgesia with local anesthetics after thoracic surgery is not associated with clear beneficial effects on postoperative pain, although results of studies were somewhat inconsistent.[154] In addition, this technique might be associated with potential toxicity because of the high systemic absorption of local anesthetics from the intrapleural space. If intrapleural analgesia with local anesthetics is used, it should be as part of a multimodal approach with close monitoring for potential toxicity.[64]

Use of Peripheral Regional Anesthesia

Recommendation 23

- The panel recommends that clinicians consider surgical site–specific peripheral regional anesthetic techniques in adults and children for procedures with evidence indicating efficacy (strong recommendation, high-quality evidence).

The use of peripheral regional anesthetic techniques have been shown to be effective as a component of multimodal analgesia for management of postoperative pain associated with a number of surgical procedures, including thoracotomy,[154,155] lower extremity joint surgery,[97,158,162,184,227,242,257,261,307,315] shoulder surgery,[242] cesarean section,[19] hemorrhoid surgery,[209] and circumcision.[14,135,163] Clinicians should consider use of surgical site–specific peripheral regional analgesic techniques in adults and children as part of multimodal analgesia, particularly in patients who undergo lower extremity and upper extremity surgical procedures. Clinicians should be familiar with the specific regional anesthetic techniques used, including use of ultrasound guidance, as well as the potential for motor blockade and risk of falls. Clinicians should also be aware of case reports of critical failures involving elastomeric pumps resulting in early delivery or complete emptying of the pump, in some cases resulting in death. Unlike electronic pumps, elastomeric pumps do not have alarms; if used, they require staff and patient and/or caregiver monitoring for pump failure and education regarding the signs and symptoms and emergency management of local anesthetic toxicity.

Recommendation 24

- The panel recommends that clinicians use continuous, local anesthetic–based peripheral regional analgesic techniques when the need for analgesia is likely to exceed the duration of effect of a single injection (strong recommendation, moderate-quality evidence).

Although single injection and continuous peripheral regional analgesic techniques are effective for postoperative analgesia in patients who undergo a number of surgical procedures,[222,242] the use of continuous rather than single-injection peripheral techniques is preferred when the duration of postoperative pain is likely to be more prolonged, because of the limited duration of analgesia expected with a single injection.

Recommendation 25

- The panel recommends that clinicians consider the addition of clonidine as an adjuvant for prolongation of analgesia with a single-injection peripheral neural blockade (weak recommendation, moderate-quality evidence).

For single-injection peripheral neural blockade with a local anesthetic, the combination of adjuvant agents administered as part of the injection might prolong the duration of analgesia and potentially reduce the need for a continuous infusion. In such circumstances, clinicians might consider the use of clonidine as an adjuvant agent in persons who receive a single-injection peripheral neural blockade. However, potential side effects must be weighed against any possible gains related to prolongation of analgesia. For instance, a meta-analysis[78,231] indicated that the addition of clonidine prolongs the duration of a single-injection peripheral neural blockade by approximately 2 hours, but is also associated with increased risk of hypotension, syncope, and sedation.

Use of Neuraxial Therapies

Recommendation 26

- The panel recommends that clinicians offer neuraxial analgesia for major thoracic and abdominal procedures, particularly in patients at risk for cardiac complications, pulmonary complications, or prolonged ileus (strong recommendation, high-quality evidence).

Epidural analgesia with local anesthetics (with or without opioids) or spinal analgesia (intrathecal opioid) in adults and children is associated with lower postoperative pain scores or decreased rescue analgesic use compared with placebo injections or systemic opioid analgesia in patients who underwent a variety of surgeries.[154,212] Epidural or spinal analgesia might be associated with a decreased risk of postoperative mortality, venous thromboembolism, myocardial infarction, pneumonia, and respiratory depression, and decreased duration of ileus versus systemic analgesia, although such benefits were primarily observed in older trials that might have used outdated systemic analgesia techniques.[18,232,233,243] Therefore, clinicians should routinely consider use of epidural or spinal analgesia for management of postoperative pain in patients who undergo major thoracic and abdominal procedures, cesarean section, and hip and lower extremity surgeries, particularly in patients at risk for cardiac complications, pulmonary complications, or prolonged ileus. A potential advantage of epidural analgesia is that it can be performed as a continuous infusion or as PCA with local anesthetics, whereas spinal analgesia is limited to a single dose of opioids. The coadministration of epidural clonidine with local anesthetics might be associated with improved analgesia in the postoperative period compared with epidural local anesthetic alone, but there is insufficient evidence to recommend its routine use and it is associated with increased risk of hypotension.[90]

Recommendation 27

- The panel recommends that clinicians avoid the neuraxial administration of magnesium, benzodiazepines, neostigmine, tramadol, and ketamine in the treatment of postoperative pain (strong recommendation, moderate-quality evidence).

Evidence on the effectiveness of adjuvant medications administered using the epidural or spinal route with local anesthetics (with or without opioids) is limited.[90] Neuraxial administration of magnesium, benzodiazepines, neostigmine, tramadol, and ketamine in the treatment of postoperative pain is not recommended because of no clear benefit and insufficient evidence to determine safety.[13,52,208,294] In addition, most of these medications are not available in a preservative-free formulation.[90]

Recommendation 28

- The panel recommends that clinicians provide appropriate monitoring of patients who have received neuraxial interventions for perioperative analgesia (strong recommendation, low-quality evidence).

Although neuraxial analgesia is associated with a decreased risk of perioperative mortality and pulmonary and cardiac complications compared with systemic opioids, adverse effects including respiratory depression, hypotension, and motor weakness from spinal cord compression (due to infection or hematoma) can occur.[154] In patients with hip and lower extremity surgeries, neuraxial analgesia might mask symptoms of compartment syndrome. Therefore, clinicians should monitor patients who have received neuraxial interventions for these adverse effects and be prepared to treat with dose reductions, removal of catheters, opioid antagonists, decompression surgery for cord-impinging epidural hematoma or abscess, antibiotics, or other measures as needed.

Organizational Structure, Policies, and Procedures

Recommendation 29

- The panel recommends that facilities in which surgery is performed have an organizational structure in place to develop and refine policies and processes for safe and effective delivery of postoperative pain control (strong recommendation, low-quality evidence).

Facilities in which surgery is performed should have an organizational structure to oversee the development, implementation, and evaluation of policies and practices to assure safe, evidence-based, and effective postoperative pain control. Whether through an existing quality improvement committee or a designated pain management team, the process should ideally be interdisciplinary. Findings in other areas of health care highlight the critical role of administrative and physician leadership including those most integrally involved in perioperative pain management for the success of such efforts.[37] Measurement-driven models of care through outcomes assessment might be useful to guide quality improvement efforts in postoperative pain control. Although the specific measurement tools and methodology might vary, outcomes management should drive refinement of

policies and processes and health systems are encouraged to standardize and use valid and reliable measures.

Recommendation 30

- The panel recommends that facilities in which surgery is performed provide clinicians with access to consultation with a pain specialist for patients with inadequately controlled postoperative pain or at high risk of inadequately controlled postoperative pain (eg, opioid-tolerant, history of substance abuse) (strong recommendation, low-quality evidence).

Management of postoperative pain can be a challenge, and require advanced assessment and management skills available from pain specialists. In some cases, postoperative pain might be inadequately controlled despite the use of standard multimodal interventions. Consultation or referral to a pain specialist might be necessary to assist in the management of such patients, to assist with diagnosis, interventional treatment, or management of comorbid conditions. Facilities in which surgery is performed should ensure that access to such expertise is readily available when needed.

Consultative expertise might also be required in patients with opioid tolerance, particularly in those with a history of substance abuse or addiction.[120,144,244] Adequate pain treatment should not be withheld from patients with active or previous opioid addiction because of fears of worsening addiction or precipitation of relapse. In addition to the ethical requirement to address postoperative pain, poorly treated pain can be a trigger for relapse. Successful treatment of such individuals might include measures to prevent relapse and require the involvement of a specialist trained in the assessment and management of chemical dependency and addiction disorders. The clinical problems of underlying chronic pain, persistent acute pain, and addiction are each complex entities with biological, psychosocial, and functional components.[134] An interdisciplinary approach using pharmacologic and nonpharmacologic interventions might be required to achieve successful postoperative outcomes and should be considered as part of the perioperative management plan in these patients (Table 4).

Recommendation 31

- The panel recommends that facilities in which neuraxial analgesia and continuous peripheral blocks are performed have policies and procedures to support their safe delivery and trained individuals to manage these procedures (strong recommendation, low-quality evidence).

Providers managing regional or neuraxial techniques should have the commensurate education, training, oversight, and experience to assure safe and effective therapy. Facilities that provide regional or neuraxial techniques should have clearly defined policies and procedures in place for appropriate patient monitoring and competency based training and education for staff involved in caring for these patients. This should include clear and reliable means for hospital and nursing staff to reach the specialists managing these techniques.

Transitioning to Outpatient Care

Recommendation 32

- The panel recommends that clinicians provide education to all patients (adult and children) and primary caregivers on the pain treatment plan including tapering of analgesics after hospital discharge (strong recommendation, low-quality evidence).

Research on methods and outcomes of discharge planning and follow-up are scarce and insufficient to provide strong guidance on optimal methods.[240] Nonetheless, anecdotal reports and clinical experience suggest the need for appropriate discharge teaching and coordination of transition to the medical home as part of the postoperative pain management plan. A coordinated approach to discharge instruction is important, including advice from prescribers, nurses, physiotherapists, and pharmacists. Clarity should be established about with whom and when to follow-up for questions and transition of care back to the primary provider.

Patients should be counseled on how to take pain medications safely and to manage side effects to optimize pain control and recovery with return to usual activities. This might be particularly important for the

Table 4. Management of Postoperative Pain in Patients Receiving Long-Term Opioid Therapy

- Conduct preoperative evaluation to determine preoperative opioid use and doses
- Provide education regarding use of opioids before surgery
- Recognize that postoperative opioid requirements will typically be greater and that pain might be more difficult to control
- Consider pain specialty consultation (and in some cases behavioral and/or addiction consultation) for pain that is difficult to manage and complex cases
- Consider nonpharmacological interventions
  - Transcutaneous electrical nerve stimulation
  - Cognitive–behavioral therapies
- Consider nonopioid systemic medications
  - Gabapentin or pregabalin
  - Ketamine
- Consider local anesthetic-based peripheral regional and neuraxial local analgesic techniques
- Consider PCA with basal infusion of opioids for difficult to manage pain with appropriate monitoring
- Provide education and instructions on tapering opioids to target dose after discharge

Table 5. Summary of Interventions for Management of Postoperative Pain

Intervention	*Suggested Use*	*Comments*	*Contraindications and Cautions*
Nonpharmacologic therapies			
Transcutaneous electrical nerve stimulation	Consider as an adjunct to other postoperative pain management treatments	Typically applied at incision site	Pacemaker or implanted defibrillator, lymphedema, broken skin
Cognitive modalities	Consider as an adjunct to other postoperative pain management treatments	Includes guided imagery and other relaxation methods, hypnosis, intraoperative suggestions, and music Might require preoperative education and patient training for optimal results	None, caution in patients with history of psychosis
Systemic pharmacologic therapies			
Acetaminophen and NSAIDs	Use as component of multimodal analgesia	No clear difference between i.v. and oral administration Reduces use of postoperative opioids Celecoxib usually dosed at 200 to 400 mg 30 minutes to 1 hour preoperatively and then 200 mg b.i.d. postoperatively Acetaminophen usually dosed at 500 to 1000 mg p.o. or i.v. every 6 hours Some observational evidence of association between high-dose NSAIDs and nonunion in spinal fusion and surgery for fractures, and between NSAID use and anastomotic leak in intestinal surgery. NSAIDs contraindicated in patients who undergo coronary artery bypass surgery.	Acetaminophen: hepatotoxicity NSAIDs: gastrointestinal bleeding and ulceration, cardiovascular events, renal dysfunction
Oral opioids	Use as component of multimodal analgesia	Oral is the preferred route for patients who can take oral medications	Respiratory depression, potential for addiction and abuse, sedation, nausea and vomiting, constipation
Patient controlled i.v. analgesia with opioids	Use when the parenteral route is needed for postoperative systemic analgesia for more than a few hours	Avoid basal infusion of opioids in opioid naive adults	See oral opioids
Gabapentin and pregabalin	Consider as a component of multimodal analgesia, primarily studied in patients who underwent major surgery, opioid-sparing	Gabapentin doses vary; in trials usually dosed at 600 to 1200 mg 1 to 2 hours preoperatively, 600 mg postoperatively (single or multiple doses) Pregabalin doses vary; in trials usually dosed at 100 or 300 mg preoperatively, or 150 or 300 mg preoperatively followed by the same dose 12 hours later Higher doses might be more effective, but might also be associated with increased sedation	Dizziness, sedation; reduced dose with renal dysfunction

Table 5. Continued

Intervention	*Suggested Use*	*Comments*	*Contraindications and Cautions*
Ketamine i.v.	Consider as a component of multimodal analgesia, in patients who undergo major surgery, opioid-sparing	Dosing varies widely, consider preoperative bolus of .5 mg/kg followed by an infusion at 10 mg/kg/min intraoperatively, with or without a postoperative infusion at a lower dose Limited evidence for use in children	Patients with history of psychosis. Hallucinations, nightmares, dissociative symptoms
Lidocaine i.v.	Consider as a component of multimodal analgesia in patients who undergo open and laparoscopic abdominal surgery	Dosing varies, consider induction dose of 1.5 mg/kg followed by 2 mg/kg/h intraoperatively	Conduction block Dizziness, seizures, bradycardia
Local, intra-articular, and topical therapies			
Local anesthetic infiltration	Use local anesthetic infiltration at incision site for surgical procedures for which there is evidence showing benefit (examples: cesarean section, laparotomy, and hemorrhoid surgery)	Clinicians should be knowledgeable regarding specific local anesthetic infiltration techniques	See Lidocaine i.v. above; also local pain, infection, bleeding
Intra-articular local anesthetic and/or opioid	Use intra-articular injections for surgical procedures for which there is evidence of benefit (examples: hip, knee, and shoulder surgery)	Clinicians should be knowledgeable regarding specific intra-articular injection techniques. Caution with use of continuous intra-articular bupivacaine in shoulder surgery because of association with chondrolysis	See Lidocaine i.v. and Oral opioids; also local pain, infection, bleeding; potential chondrolysis with intra-articular shoulder injections
Topical local anesthetics	Use in combination with penile nerve block in infants undergoing circumcision	4% Liposomal lidocaine or eutectic mixture of local anesthetics, lidocaine and procaine	See Lidocaine i.v.; also local pain, infection, bleeding, rash
Peripheral regional and neuraxial analgesic therapies			
Peripheral regional anesthetic techniques	Use as part of multimodal analgesia for surgical procedures for which there is evidence of benefit (examples: thoracotomy, lower or upper extremity surgery, hemorrhoid surgery, circumcision)	Clinicians should be familiar with specific regional anesthetic techniques Use continuous over single injection techniques when longer duration of analgesia is required	See Lidocaine; also potential for falls
Neuraxial analgesia (epidural with local anesthetic [with or without opioids] or intrathecal opioid)	Use for major thoracic, abdominal, cesarean section, and lower extremity surgery	No clear difference between continuous infusion with epidural catheter versus single dose of intrathecal morphine	See Lidocaine and Oral opioids; also motor weakness and risk of falls

Abbreviations: b.i.d., twice per day; p.o., orally.

NOTE. Table data are not listed in order of preference or strength of evidence. The choice of treatments must be made on the basis of comprehensive patient assessment and the available evidence with consideration of multiple factors including individual risk factors for adverse events, comorbidities, cost, patient response; combinations of medications and techniques are often indicated. Doses are for typical adults.

growing number of outpatient surgical patients. Patients and families should be informed that the use of other central nervous depressants (including alcohol) or illicit drugs in combination with opioids can result in accidental overdose and death. Discharge teaching should include a discussion of the plan for reduction and discontinuation of opioids as the acute pain resolves, as well as appropriate disposal of unused supplies of opioids and other medications. There is insufficient evidence to guide firm recommendation on how to wean patients with postoperative pain off of opioids. Although severe pain after surgery tends to diminish rapidly in the first few days, postoperative pain can persist for months, highlighting the need for an individualized approach. For some minor surgeries, it might be appropriate to discharge patients with use of acetaminophen or NSAIDs or a very limited supply of opioids before the transition to acetaminophen or NSAIDs. In general, patients not receiving long-term opioid therapy before surgery and treated with opioids for more than 1 to 2 weeks should be instructed to gradually reduce the opioid dose to prevent signs and symptoms of severe withdrawal. Dose reductions of approximately 20–25% of the discharge dose every day or two can be tolerated by most patients when pain is improving. Patients chronically prescribed opioids before surgery should be instructed on how to taper their opioid to their target maintenance dose.

Conclusions

After a review of the evidence, an expert panel convened by the APS, with input from the ASA, developed recommendations to promote effective management of postoperative pain; the recommendations were subsequently approved by the APS, the American Society of Regional Anesthesia and Pain Medicine, and the ASA Committee on Regional Anesthesia, Executive Committee, and Administrative Council. The recommendations are on the basis of the underlying premise that optimal management begins in the preoperative period and is on the basis of an assessment of the patient and development of a plan of care tailored to the individual and the surgical procedure involved, with follow-up assessments and adjustments as needed. The panel found that evidence supports the use of multimodal regimens in many situations, although the exact components of effective multimodal care will vary depending on the patient, setting, and surgical procedure. Suggested uses for various interventions for management of postoperative pain are summarized in Table 5.

Although these guidelines are based on a systematic review of the evidence on management of postoperative pain, the panel identified numerous research gaps. Of 32 recommendations, the panel rated only 4 as supported by high-quality evidence, and 11 recommendations were on the basis of low-quality evidence. Nonetheless, the panel came to near-unanimous consensus on almost all of its recommendations. Research is urgently needed on optimal methods for managing patients who receive opioids before surgery, effectiveness of opioid-sparing multimodal regimens, optimal methods of pain assessment and monitoring, and a number of areas related to management of perioperative pain in infants and children. There is also an urgent need to fund and conduct research on practice gaps regarding use of evidence-based interventions for management of postoperative pain.

Note

Clinical practice guidelines are "guides" only and might not apply to all patients and all clinical situations. As part of a shared decision-making approach, it might be appropriate for the clinician to inform a patient that a particular recommendation might not be applicable, after considering all circumstances pertinent to that individual. This guideline was approved by the ASA Committee on Regional Anesthesia, Executive Committee, and Administrative Council in October 2015. It has not been approved by ASA's House of Delegates or Board of Directors and does not represent an official or approved statement or policy of the ASA.

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Supplementary Data

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