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Practice Guidelines for Acute Pain Management in the Perioperative Setting

An Updated Report by the American Society of Anesthesiologists Task Force on Acute Pain Management

PRACTICE guidelines are systematically developed recommendations that assist the practitioner and patient in making decisions about health care. These recommendations may be adopted, modified, or rejected according to clinical needs and constraints.

Practice guidelines are not intended as standards or absolute requirements. The use of practice guidelines cannot guarantee any specific outcome. Practice guidelines are subject to revision as warranted by the evolution of medical knowledge, technology, and practice. They provide basic recommendations that are supported by analysis of the current literature and by a synthesis of expert opinion, open forum commentary, and clinical feasibility data.

This revision includes data published since the "Practice Guidelines for Acute Pain Management in the Perioperative Setting" were adopted by the American Society of Anesthesiologists (ASA) in 1994; it also includes data and recommendations for a wider range of management techniques than was previously addressed. The approaches to identification and retrieval of pertinent literature, as well as its synthesis, reflect the continuous evolution in the field of practice guideline development since 1994.

The reference list can also be found on the ANESTHESIOLOGY Web site. Go to http://www.anesthesiology.org, click on Enhancements Index, and then scroll down to find the appropriate article and link. Alternatively, the reference list can be accessed on the Web by clicking on the "ArticlePlus" link either in the Table of Contents or at the top of the Abstract or HTML version of the Guidelines.

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The accompanying Web site enhancement is a bibliography.

Address reprint requests to the American Society of Anesthesiologists: 520 North Northwest Highway, Park Ridge, Illinois 60068–2573. Individual Practice Guidelines may be obtained at no cost through the Journal Web site, www.anesthesiology.org.

Methodology

A. Definition of Acute Pain in the Perioperative Setting

For these Guidelines, acute pain in the perioperative setting is defined as pain that is present in a surgical patient because of preexisting disease, the surgical procedure (with associated drains, chest or nasogastric tubes, or complications), or a combination of disease-related and procedure-related sources.

B. Purpose of the Guidelines

The purpose of these Guidelines is to (1) facilitate the safety and effectiveness of acute pain management in the perioperative setting; (2) reduce the risk of adverse outcomes; (3) maintain the patient's functional abilities, as well as physical and psychological well-being; and (4) enhance the quality of life for patients with acute pain during the perioperative period. Adverse outcomes that may result from the *undertreatment* of perioperative pain include (but are not limited to) thromboembolic and pulmonary complications, additional time spent in an intensive care unit or hospital, hospital readmission for further pain management, needless suffering, impairment of health-related quality of life, and development of chronic pain. Adverse outcomes associated with the *management* of perioperative pain include (but are not limited to) respiratory depression, brain or other neurologic injury, sedation, circulatory depression, nausea, vomiting, pruritus, urinary retention, impairment of bowel function, and sleep disruption. Health-related quality of life includes (but is not limited to) physical, emotional, social, and spiritual well-being.

C. Focus

These Guidelines focus on acute pain management in the perioperative setting for adult (including geriatric) and pediatric patients undergoing either inpatient or outpatient surgery. Modalities for perioperative pain management addressed in these Guidelines require a higher level of professional expertise and organizational structure than "as needed" intramuscular or intravenous injections of opioid analgesics. These Guidelines are not intended as an exhaustive compendium of specific techniques.

Patients with severe or concurrent medical illness such as sickle cell crisis, pancreatitis, or acute pain related to cancer or cancer treatment may also benefit from aggres-

sive pain control. Labor pain is another condition of interest to anesthesiologists. However, the complex interactions of concurrent medical therapies and physiologic alterations make it impractical to address pain management for these populations within the context of this document.

While patients undergoing painful procedures may benefit from the appropriate use of anxiolytics and sedatives in combination with analgesics and local anesthetics when indicated, these Guidelines do not specifically address the use of anxiolysis or sedation during such procedures.

D. Application

These Guidelines are intended for use by anesthesiologists and individuals who deliver care under the supervision of anesthesiologists. The Guidelines may also serve as a resource for other physicians and healthcare professionals who manage perioperative pain. In addition, these Guidelines are intended for use by policymakers to promote effective and patient-centered care.

Anesthesiologists bring an exceptional level of interest and expertise to the area of perioperative pain management. Anesthesiologists are uniquely qualified and positioned to provide leadership in integrating pain management within perioperative care. In this leadership role, anesthesiologists improve quality of care by developing and directing institution-wide, interdisciplinary perioperative analgesia programs.

E. Task Force Members and Consultants

The ASA appointed a Task Force of nine members to (1) review the published evidence, (2) obtain the opinions of anesthesiologists selected by the Task Force as consultants, and (3) build consensus within the community of practitioners likely to be affected by the Guidelines. The Task Force included anesthesiologists in both private and academic practices from various geographic areas of the United States, and consulting methodologists from the ASA Committee on Practice Parameters.

These Guidelines update the 1995 publication of *Practice Guidelines for Acute Pain Management in the Perioperative Setting*.* The Task Force revised the earlier Guidelines by reviewing and evaluating original published research studies retrieved from multiple sources. The draft document was made available for review on the ASA Web site, and input was invited *via* e-mail announcement to all ASA members. All submitted comments were considered by the Task Force in preparing the final draft.

F. Availability and Strength of Evidence

Preparation of these Guidelines followed a rigorous methodologic process (Appendix). To convey the findings in a concise fashion, these Guidelines employ several descriptive terms that are easier to understand than the technical terms used in the actual analyses.

When sufficient numbers of studies are available for evaluation, the following terms describe the strength of the findings.

Supportive: Meta-analyses of a sufficient number of adequately designed studies indicate a statistically significant relationship ($P < 0.01$) between a clinical intervention and a clinical outcome.

Suggestive: Information from case reports and descriptive studies permits inference of a relationship between an intervention and an outcome. This type of qualitative information does not permit a statistical assessment of significance.

Equivocal: Qualitative data are not adequate to permit inference of a relationship between an intervention and an outcome and (1) there is insufficient quantitative information, or (2) aggregated comparative studies have found no significant differences among groups or conditions.

The *lack* of scientific evidence in the literature is described by the following terms.

Silent: No identified studies address the relationship of interest.

Insufficient: There are too few published studies to investigate a relationship between an intervention and an outcome.

Inadequate: The available studies cannot be used to assess the relationship between an intervention and an outcome. These studies either do not meet the criteria for content as defined in the "Focus" of these Guidelines, or they do not permit a clear causal interpretation of findings because of methodologic concerns.

Guidelines

I. Institutional Policies and Procedures for Providing Perioperative Pain Management

Institutional policies and procedures include (but are not limited to) (1) education and training for healthcare providers, (2) monitoring of patient outcomes, (3) documentation of monitoring activities, (4) monitoring of outcomes at an institutional level, (5) 24-h availability of anesthesiologists providing perioperative pain management, and (6) use of a dedicated Acute Pain Service. The literature suggests that education and training for healthcare providers is associated with decreased pain intensity. The published evidence is insufficient to evaluate the effects of monitoring, documentation at either the individual patient level or institutional level, and the efficacy of the 24-h availability of anesthesiologists. Although randomized comparative literature was not

* American Society of Anesthesiologists: Practice guidelines for acute pain management in the perioperative setting: A report by the American Society of Anesthesiologists Task Force on Acute Pain Management. ANESTHESIOLOGY 1995, 82:1071–81

found, pre–post studies support the efficacy of an Acute Pain Service for reducing pain and suggest that adverse effects are also decreased.

The Task Force agrees that education, training, and experience contribute to improved quality of care. The Task Force views patient and family education in planning for and participating in preoperative pain control as important to the patient's comfort and well-being. The Task Force supports 24-h availability of anesthesiologists for perioperative pain management to provide this comfort and safety. The Task Force recognizes that "analgesic gaps" are common during the transition from epidural or patient-controlled analgesia (PCA) to oral analgesic therapy, and believes that the quality improvement activities of a dedicated Acute Pain Service may reduce such gaps and enhance patient comfort. The Task Force supports the implementation of institutional policies and procedures as a logical part of interdisciplinary perioperative pain management, and recognizes their importance for institutional accreditation. Other professionals that play an important role in perioperative pain management include surgeons, nurses, pharmacists, and physical therapists.

Recommendations. Anesthesiologists offering perioperative analgesia services should provide, in collaboration with other healthcare professionals as appropriate, ongoing education and training to ensure that hospital personnel are knowledgeable and skilled with regard to the effective and safe use of the available treatment options within the institution. Educational content should range from basic bedside pain assessment to sophisticated pain management techniques (*e.g.*, epidural analgesia, patient controlled analgesia, and various regional anesthesia techniques) and nonpharmacologic techniques (*e.g.*, relaxation, imagery, hypnotic methods). For optimal pain management, ongoing education and training are essential for new personnel, to maintain skills, and whenever therapeutic approaches are modified.

Anesthesiologists and other healthcare providers should use standardized, validated instruments to facilitate the regular evaluation and documentation of pain intensity, the effects of pain therapy, and side effects caused by the therapy.

Analgesic techniques involve risk for adverse effects that may require prompt medical evaluation. Anesthesiologists responsible for perioperative analgesia should be available *at all times* to consult with ward nurses, surgeons, or other involved physicians, and should assist in evaluating patients who are experiencing problems with any aspect of perioperative pain relief.

Anesthesiologists providing perioperative analgesia services should do so within the framework of an Acute Pain Service, and participate in developing standardized institutional policies and procedures. An integrated approach to perioperative pain management that minimizes analgesic gaps includes ordering, administering, and transitioning therapies, and transferring responsibility for perioperative pain therapy, as well as outcomes assessment and continuous quality improvement.

II. Preoperative Evaluation of the Patient

Preoperative patient evaluation and planning is integral to perioperative pain management. Proactive individualized planning is an anticipatory strategy for postoperative analgesia that integrates pain management into the perioperative care of patients. Patient factors to consider in formulating a plan include type of surgery, expected severity of postoperative pain, underlying medical conditions (*e.g.*, presence of respiratory or cardiac disease, allergies), the risk-benefit ratio for the available techniques, and a patient's preferences or previous experience with pain. Although the literature is silent regarding the value of a preoperative directed pain history, a directed physical examination, or consultations with other healthcare providers, the Task Force points out the obvious value of these activities.

Recommendations. A directed pain history, a directed physical examination, and a pain control plan should be included in the anesthetic preoperative evaluation.

III. Preoperative Preparation of the Patient

Preoperative patient preparation includes (1) adjustment or continuation of medications whose sudden cessation may provoke a withdrawal syndrome, (2) treatment(s) to reduce preexisting pain and anxiety, (3) premedication(s) prior to surgery as part of a multimodal analgesic pain management program, and (4) patient and family education (including behavioral pain control techniques).

There is insufficient literature to evaluate the impact of preoperative adjustment or continuation of medications whose sudden cessation may provoke an abstinence syndrome. Similarly, there is insufficient literature to evaluate the efficacy of the preoperative initiation of treatment(s) either to reduce preexisting pain, or as part of a multimodal analgesic pain management program. The literature supports patient education for reducing anxiety and decreasing time to discharge. The literature is equivocal regarding the impact of patient education on the direct reduction of patients' pain, but indicates that lower total dosages of analgesics are used by patients receiving preoperative education.

The Task Force supports patient and family education and participation in perioperative pain control for promoting patient comfort and well-being.

Recommendations. Patient preparation for perioperative pain management should include appropriate adjustments or continuation of medications to avert an abstinence syndrome, treatment of preexistent pain, or

preoperative initiation of therapy for postoperative pain management.

Anesthesiologists offering perioperative analgesia services should provide, in collaboration with others as appropriate, patient and family education regarding their important roles in achieving comfort, reporting pain, and in proper use of the recommended analgesic methods. Common misconceptions that overestimate the risk of adverse effects and addiction should be dispelled. Patient education for optimal use of PCA and other sophisticated methods, such as patient-controlled epidural analgesia (PCEA), might include discussion of these analgesic methods at the time of the preanesthetic evaluation, brochures, and videotapes to educate patients about therapeutic options, and discussion at the bedside during postoperative visits. Such education may also include instruction in behavioral modalities for control of pain and anxiety.

IV. Perioperative Techniques for Pain Management

The literature supports the efficacy and safety of three techniques used by anesthesiologists for perioperative pain control: (1) epidural or intrathecal opioid analgesia; (2) PCA with systemic opioids; and (3) regional analgesic techniques, including but not limited to intercostal blocks, plexus blocks, and local anesthetic infiltration of incisions. The literature indicates that adverse effects are no more frequent with these three analgesic techniques than with other less effective techniques. The Task Force supports the use of epidural, PCA, and regional techniques by anesthesiologists when appropriate and feasible.

1. Epidural or intrathecal opioid analgesia: The literature supports the efficacy of epidural morphine and fentanyl for perioperative analgesia but is insufficient to characterize the spectrum of risks and benefits associated with the use of other specific opioids (*e.g.*, hydromorphone, sufentanil) given by these routes. Pruritus and urinary retention occur more frequently when morphine is given by these routes when compared to systemic administration. Epidural morphine provides more effective pain relief than intramuscular morphine. Similarly, epidural fentanyl provides more effective postoperative analgesia than intravenous fentanyl. The literature is insufficient to evaluate the effect of epidural techniques administered at different times (*e.g.*, preincisional, postincisional or postoperative).

2. PCA with systemic opioids: When compared with intramuscular techniques, the literature supports the efficacy of PCA for postoperative pain management. The literature is equivocal regarding the efficacy of PCA techniques when compared to nurse or staff-administered intravenous analgesia. In addition, the literature is equivocal regarding the comparative efficacy of patient-controlled epidural analgesia (PCEA) and intravenous PCA techniques. When background opioid infusions are included with PCA techniques, patients report better analgesia and higher morphine consumption without increased incidence of nausea, vomiting, pruritus or sedation. Although higher morphine consumption during PCA with continuous background infusion might predispose patients to respiratory depression, the literature is insufficient to reveal this adverse effect.

3. Regional techniques: The literature supports the analgesic efficacy of peripheral nerve blocks (*e.g.*, intercostal, ilioinguinal, penile, interpleural or plexus). The literature also supports postincisional infiltration with local anesthetics for postoperative analgesia. However, the literature is equivocal regarding the analgesic benefits of preincisional infiltration. The literature suggests that intraatricular analgesia with opioids, local anesthetics or combinations of the two provides analgesic benefit.

Recommendations. Anesthesiologists who manage perioperative pain should utilize therapeutic options such as epidural or intrathecal opioids, systemic opioid PCA, and regional techniques, after thoughtfully considering the risks and benefits for the individual patient. These modalities should be used in preference to intramuscular opioids ordered "as needed." The therapy selected should reflect the individual anesthesiologist's expertise, as well as the capacity for safe application of the modality in each practice setting. This capacity includes the ability to recognize and treat adverse effects that emerge after initiation of therapy. Special caution should be taken when continuous infusion modalities are used, as drug accumulation may contribute to adverse events.

V. Multimodal Techniques for Pain Management

The literature supports the administration of two analgesic agents that act by different mechanisms *via* a single route for providing superior analgesic efficacy with equivalent or reduced adverse effects. Examples include epidural opioids administered in combination with epidural local anesthetics or clonidine, and intravenous opioids in combination with ketorolac or ketamine. Dose-dependent adverse effects reported with administration of a medication occur whether it is given alone or in combination with other medications (*e.g.*, opioids may cause nausea, vomiting, pruritus or urinary retention, and local anesthetics may produce motor block). The literature is insufficient to evaluate the postoperative analgesic effects of oral opioids combined with nonsteroidal antiinflammatory drugs (NSAIDs) (*e.g.*, ibuprofen, ketorolac), cyclooxygenase-2 inhibitors (COXIBs) (*e.g.*, celecoxib, rofecoxib, parecoxib), or acetaminophen when compared with oral opioids alone. The Task Force believes that NSAID, COXIB or acetaminophen administration has a dose-sparing effect for systemically administered opioids.

The literature suggests that two routes of administration, when compared with a single route, may be more effective in providing perioperative analgesia. Examples

include (1) epidural or intrathecal opioid analgesia combined with intravenous, intramuscular, oral, transdermal or subcutaneous analgesics *versus* epidural opioids alone; or (2) intravenous opioids combined with oral NSAIDs, COXIBs, or acetaminophen *versus* intravenous opioids. The literature is insufficient to evaluate the efficacy of pharmacologic pain management combined with nonpharmacologic, alternative or complementary pain management when compared to pharmacologic pain management alone.

Recommendations. Whenever possible, anesthesiologists should employ multimodal pain management therapy. Unless contraindicated, all patients should receive an around-the-clock regimen of NSAIDs, COXIBs, or acetaminophen. In addition, regional blockade with local anesthetics should be considered. Dosing regimens should be administered to optimize efficacy while minimizing the risk of adverse events. The choice of medication, dose, route, and duration of therapy should be individualized.

VI. Patient Subpopulations

Some patient groups are at special risk for inadequate pain control, and require additional analgesic considerations. Patient populations at risk include (1) pediatric patients, (2) geriatric patients, and (3) critically ill or cognitively impaired patients, or other patients who may have difficulty communicating. The Task Force believes that genetics and gender modify the pain experience and response to analgesic therapies. In addition, the Task Force believes that patient race, ethnicity, culture, gender, and socioeconomic status influence access to treatment as well as pain assessment by healthcare providers.

1. Pediatric Patients. The Task Force believes that optimal care for infants and children (including adolescents) requires special attention to the biopsychosocial nature of pain. This specific patient population presents developmental differences in their experience and expression of pain and suffering, and their response to analgesic pharmacotherapy. Caregivers in both the home and hospital may have misperceptions regarding the importance of analgesia as well as its risks and benefits. In the absence of a clear source of pain or obvious pain behavior, caregivers may assume that pain is not present, and defer treatment. Safe methods for providing analgesia are underutilized in pediatric patients for fear of opioid-induced respiratory depression.

The emotional component of pain is particularly strong in infants and children. Absence of parents, security objects, and familiar surroundings may cause as much suffering as the surgical incision. Children's fear of injections makes intramuscular or other invasive routes of drug delivery aversive. Even the valuable technique of topical analgesia prior to injections may not lessen this fear.

The literature suggests that a variety of techniques are effective in providing analgesia in pediatric patients. Many are the same as for adults, although some (*e.g.*, caudal analgesia) are more commonly used in children. The Task Force believes that it is important for caregivers to recognize that pediatric patients require special consideration to ensure optimal perioperative analgesia.

Recommendations. Aggressive and proactive pain management is necessary to overcome the historic undertreatment of pain in children. Perioperative care for children undergoing painful procedures or surgery requires developmentally appropriate pain assessment and therapy. Analgesic therapy should depend on age, weight, and comorbidity, and unless contraindicated should involve a multimodal approach. Behavioral techniques, especially important in addressing the emotional component of pain, should be applied whenever feasible.

Sedative, analgesic, and local anesthetics are all important components of appropriate analgesic regimens for painful procedures. As many analgesic medications are synergistic with sedating agents, it is imperative that appropriate monitoring be employed during the procedure and recovery.

2. Geriatric Patients. Elderly patients may suffer from conditions such as arthritis or cancer that render them more likely to undergo surgery. The Task Force believes that pain is often undertreated, and elderly individuals may be more vulnerable to the detrimental effects of such undertreatment. The physical, social, emotional, and cognitive changes associated with aging have an impact on perioperative pain management. These patients may have different attitudes than younger adult patients in expressing pain and seeking appropriate therapy. Altered physiology changes the way analgesic drugs and local anesthetics are distributed and metabolized, and frequently requires dose alterations.

The literature suggests that techniques effective in younger adults also benefit geriatric patients without an age-related increase in adverse effects. The literature also suggests that perioperative analgesics are provided in lower dosages to older adults than to younger adults. The Task Force believes that, although the reasons for lower perioperative analgesic doses in the elderly are unclear, undertreatment of pain in elderly persons is widespread.

Recommendations. Pain assessment and therapy should be integrated into the perioperative care of geriatric patients. Pain assessment tools appropriate to a patient's cognitive abilities should be employed. Extensive and proactive evaluation and questioning may be necessary to overcome barriers that hinder communication regarding unrelieved pain. Anesthesiologists should recognize that geriatric patients might respond differently than younger patients to pain and analgesic medications, often because of comorbidity. Vigilant dose titration is necessary to ensure adequate treatment while avoiding adverse effects such as somnolence in this vul-

nerable group, who are often taking other medications (including alternative and complementary agents).

3. Other Groups. Patients who are critically ill, cognitively impaired (*e.g.*, Alzheimer's disease), or who otherwise have difficulty communicating (*e.g.*, cultural or language barriers) present unique challenges to perioperative pain management. The Task Force believes that techniques that reduce drug dosages required to provide effective analgesia (*e.g.*, regional analgesia and multimodal analgesia) may be suitable for such patients. Behavioral modalities and techniques such as PCA that depend on self-administration of analgesics are generally less suitable for the cognitively impaired. The literature is insufficient to evaluate the application of pain assessment methods or pain management techniques specific to these populations.

Recommendations. Anesthesiologists should recognize that patients who are critically ill, cognitively impaired, or have communication difficulties may require additional interventions to ensure optimal perioperative pain management. Anesthesiologists should consider a therapeutic trial of an analgesic in patients with elevated blood pressure and heart rate or agitated behavior, when causes other than pain have been excluded.

Appendix: Methods and Analyses

The scientific assessment of these Guidelines was based on evidence linkages or statements regarding potential relationships between clinical interventions and outcomes. The interventions listed below were examined to assess their relationship to a variety of outcomes related to the management of acute pain in the perioperative setting.

1. Institutional policies and procedures for providing perioperative pain management: (a) Education and training of healthcare providers. (b) Monitoring of patient outcomes. (c) Documentation of monitoring activities. (d) Monitoring of outcomes at an institutional level. (e) 24-h availability of anesthesiologists providing perioperative pain management. (f) Acute pain service.
2. Preoperative evaluation of the patient: (a) A directed pain history (*e.g.*, medical record review and patient interview to include current medications, adverse effects, preexisting pain conditions, medical conditions that would influence a pain therapy, nonpharmacologic pain therapies, alternative and complimentary therapies). (b) A directed physical examination. (c) Consultations with other health-care providers (*e.g.*, nurses, surgeons, pharmacists).
3. Preoperative preparation of the patient: (a) Preoperative adjustment or continuation of medications whose sudden cessation may provoke an abstinence syndrome. (b) Preoperative treatment(s) to reduce preexisting pain and anxiety. (c) Premedication(s) prior to surgery as part of a multimodal analgesic pain management program. (d) Patient and family education.
4. Perioperative techniques for pain management: (a) Epidural or intrathecal analgesia with opioids (*versus* epidural placebo, epidural local anesthetics, or intravenous, intramuscular, or oral opioids). (b) Patient-controlled analgesia with opioids: (i) Intravenous PCA *versus* nurse-controlled or continuous intravenous. (ii) Intravenous PCA *versus* intramuscular. (iii) *Epidural PCA versus* epidural bolus or infusion. (iv) *Epidural PCA versus* intravenous PCA. (v) Intravenous PCA with background infusion of opioids *versus* no background infusion. (c) Regional analgesia with local anesthetics or opioids (*e.g.*, intercostal blocks, plexus blocks, intraarticular blocks, local infiltration of incisions): (i) Intercostal or interpleural blocks. (ii) Plexus and other blocks. (iii) Intraarticular opioids, local anesthetics, or combinations. (iv) Infiltration of incisions.
5. Multimodal techniques (epidural, intravenous, or regional): (a) Two or more analgesic agents, one route *versus* a single agent, one route: (i) Epidural or intrathecal analgesia with opioids combined with: (*1*) local anesthetics *versus* epidural opioids. (*2*) local anesthetics *versus* epidural local anesthetics. (*3*) *clonidine versus* epidural opioids. (ii) Intravenous opioids combined with: (*1*) *clonidine versus* intravenous opioids. (*2*) *ketorolac versus* intravenous opioids. (*3*) *ketamine versus* intravenous opioids. (iii) Oral opioids combined with NSAIDs, COXIBs, or acetaminophen *versus* oral opioids. (b) Two or more drug delivery routes *versus* a single route: (i) Epidural or intrathecal analgesia with opioids combined with intravenous, intramuscular, oral, transdermal or subcutaneous analgesics *versus* epidural opioids. (ii) Intravenous opioids combined with oral NSAIDs, COXIBs, or acetaminophen *versus* intravenous opioids. (c) Nonpharmacologic, alternative, or complementary pain management combined with pharmacologic pain management *versus* pharmacologic pain management.
6. Special patient populations: (a) Pain management techniques for pediatric patients: (i) Pain assessment techniques. (ii) Dose level adjustments. (iii) Avoidance of repetitive diagnostic evaluation (heel sticks) for neonates. (b) Pain management techniques for geriatric patients: (i) Pain assessment techniques. (ii) Dose level adjustments. (c) Pain management techniques for other special populations (*e.g.*, cognitively impaired, critically ill, patients with difficulty communicating): (i) Pain assessment methods specific to special populations. (ii) Pain management techniques specific to special populations.

Scientific evidence was derived from aggregated research literature, and from surveys, open presentations and other consensus-oriented activities (*e.g.*, Internet posting). For purposes of literature aggregation, potentially relevant clinical studies were identified *via* electronic and manual searches of the literature. The electronic search covered a 38-yr period from 1966 through 2003. The manual search covered a 42-yr period from 1952 through 2003. More than 4,000 citations were initially identified, yielding a total of 1,695 nonoverlapping articles that addressed topics related to the evidence linkages. After review of the articles, 1,067 studies did not provide direct evidence, and were subsequently eliminated. A total of 628 articles contained direct linkage-related evidence.

A directional result for each study was initially determined by a literature count, classifying each outcome as either supporting a linkage, refuting a linkage, or neutral. The results were then summarized to obtain a directional assessment for each linkage prior to conducting formal meta-analysis. Literature pertaining to 15 evidence linkages contained enough studies with well-defined experimental designs and statistical information sufficient for meta-analyses. These linkages were (1) acute pain service, (2) patient and family education, (3) epidural or intrathecal opioids, (4) intravenous PCA *versus* nurse-controlled or continuous intravenous, (5) intravenous PCA *versus* intramuscular, (6) epidural PCA *versus* intravenous PCA, (7) intravenous PCA with background infusion of opioids *versus* no background infusion, (8) intercostal or interpleural blocks, (9) plexus and other blocks, (10) infiltration of incisions, (11) epidural opioids combined with local anesthetics *versus* epidural opioids, (12) epidural opioids combined with local anesthetics *versus* epidural local anesthetics, (13) epidural opioids combined with clonidine *versus* epidural opioids, (14) intravenous opioids combined with ketorolac *versus* intravenous opioids, and (15) intravenous opioids combined with ketamine *versus* intravenous opioids.

General variance-based effect-size estimates or combined probability tests were determined for continuous outcome measures, and Mantel-Haenszel odds-ratios were determined for dichotomous outcome measures. Two combined probability tests were employed as follows: (1) The Fisher combined test, producing chi-square values based on logarithmic transformations of the reported *P* values from the independent

studies; and (2) the Stouffer combined test, providing weighted representation of the studies by weighting each of the standard normal deviates by the size of the sample. An odds-ratio procedure based on the Mantel-Haenszel method for combining study results using 2×2 tables was used with outcome frequency information. An acceptable significance level was set at $P < 0.01$ (one-tailed). Tests for heterogeneity of the independent studies were conducted to assure consistency among the study results. DerSimonian-Laird random-effects odds ratios were considered when significant heterogeneity was found. To control for potential publishing bias, a "fail-safe n" value was calculated. No search for unpublished studies was conducted, and no reliability tests for locating research results were performed.

Meta-analytic results are reported in Table 1. To be considered acceptable findings of significance, Mantel-Haenszel odds-ratios must agree with combined test results when both types of data are assessed. In the absence of Mantel-Haenszel odds-ratios, both the Fisher and weighted Stouffer combined test results must agree with each other to be considered acceptable findings of significance.

Interobserver agreement among Task Force members and two methodologists was established by interrater reliability testing. Agreement levels using a kappa (κ) statistic for two-rater agreement pairs were as follows: (1) type of study design, $\kappa = 0.63$ to 0.94; (2) type of analysis, $\kappa = 0.39$ to 0.89; (3) evidence linkage assignment, $\kappa = 0.74$ to 0.96; and (4) literature inclusion for database, $\kappa = 0.75$ to 0.88. Three-rater chance-corrected agreement values were: (1) study design, Sav = 0.80, Var (Sav) = 0.007; (2) type of analysis, Sav = 0.59, Var (Sav) = 0.032; (3) linkage assignment, Sav = 0.73 Var (Sav) = 0.010; (4) literature database inclusion, Sav = 0.83 Var (Sav) = 0.015. These values represent moderate levels of agreement.

The findings of the literature analyses were supplemented by the opinions of Task Force members after considering opinions derived from a variety of sources, including informal commentary and comments from postings of the draft document on the ASA Web site. In addition, opinions obtained from consultant surveys, open forum commentary and other sources used in the original Guidelines were reviewed and considered.

Table 1. Meta-analysis Summary

Linkages	n	Fisher Chi-square	*P*	Weighted Stouffer Zc	*P*	Effect Size	Mantel-Haenszel OR	CI	Heterogeneity Significance	Heterogeneity Effect Size
Institutional policies										
Acute pain service										
Pain scores*	5	—	—	—	—	—	2.23†	1.24–3.82	—	0.008
Preoperative preparation										
Education of patients										
Pain scores*	6	34.62	0.004	1.20	0.115	0.08‡	—	—	0.060	0.018
Analgesic use*	6	39.64	0.001	2.74	0.003	0.18	—	—	0.420	0.280
Anxiety*	10	66.46	0.001	3.91	0.001	0.20	—	—	0.650	0.270
Time to discharge*	8	57.14	0.001	2.88	0.001	0.15	—	—	0.005	0.005
Perioperative techniques										
Epidural/intrathecal opioids										
Preincisional morphine *vs.* saline										
Pain scores	5	76.22	0.001	2.73	0.003	0.53	—	—	0.600	0.070
Nausea/vomiting	5	—	—	—	—	—	1.32	0.41–4.24	—	0.600
Postincisional morphine *vs.* saline										
Nausea/vomiting	7	—	—	—	—	—	0.86†	0.20–2.79	—	0.001
Pruritus	6	—	—	—	—	—	0.11†	0.004–7.72	—	0.001
Postincisional morphine *vs.* IM morphine										
Pain scores	6	81.33	0.001	5.57	0.001	0.82	—	—	0.260	0.001
Pruritus	6	—	—	—	—	—	0.18	0.06–0.58	—	0.710
Postoperative morphine *vs.* IM morphine										
Pain scores	9	104.06	0.001	5.64	0.001	0.45	—	—	0.330	0.001
Nausea/vomiting	11	—	—	—	—	—	0.93	0.50–1.76	—	0.150
Pruritus	6	—	—	—	—	—	0.14	0.06–0.34	—	0.990
Urinary retention	7	—	—	—	—	—	0.34	0.17–0.68	—	0.680
Postoperative fentanyl *vs.* IV fentanyl										
Pain scores	5	28.17	0.002	3.35	0.001	0.24	—	—	0.600	0.780
Nausea/vomiting	5	—	—	—	—	—	1.82†	0.16–38.28	—	0.005
Pruritus	5	—	—	—	—	—	0.83	0.20–3.49	—	0.600
Patient-controlled analgesia										
IV PCA *vs.* nurse-admin IV										
Pain scores	5	47.80	0.001	1.66	0.049	0.17	—	—	0.001	0.001
IV PCA *vs.* IM										
Pain scores	12	99.07	0.001	4.04	0.001	0.27‡	—	—	0.011	0.001
Sedation	6	29.03	0.005	2.35	0.009	0.17	—	—	0.550	0.550
Epidural PCA *vs.* IV PCA										
Pain scores	7	50.61	0.001	3.35	0.001	0.18	—	—	0.001	0.001
Nausea/vomiting	5	19.04	0.040	2.07	0.019	0.16	—	—	0.650	0.600
PCA with background opioids										
Pain scores	8	44.45	0.001	3.74	0.001	0.20	—	—	0.450	0.400
Analgesic use	7	98.97	0.001	5.93	0.001	0.43‡	—	—	0.010	0.001
Nausea/vomiting	7	—	—	—	—	—	1.02	0.53–2.00	—	0.290
Pruritus	6	—	—	—	—	—	0.90	0.43–1.88	—	0.450
Sedation	6	19.04	0.075	1.96	0.025	0.09	—	—	0.730	0.650
Regional analgesia										
Intercostal/interpleural blocks										
Postincisional *vs.* no block										
Pain scores	6	62.66	0.001	6.66	0.001	0.40	—	—	0.040	0.001
Postoperative *vs.* no block										
Pain scores	11	99.30	0.001	2.64	0.004	0.35	—	—	0.400	0.001
Plexus and other blocks										
Preincisional *vs.* no block										
Pain scores	10	116.12	0.001	7.33	0.001	0.45‡	—	—	0.001	0.001
Analgesic use	5	45.16	0.001	3.49	0.001	0.34	—	—	0.350	0.030
Nausea/vomiting	6	—	—	—	—	—	1.56	0.68–3.60	—	0.480
Postincisional *vs.* no block										
Pain scores	6	67.58	0.001	6.52	0.001	0.67	—	—	0.220	0.001

(*continues*)

Table 1. (continued)

Linkages	n	Fisher Chi-square	*P*	Weighted Stouffer Zc	*P*	Effect Size	Mantel-Haenszel OR	CI	Heterogeneity Significance	Heterogeneity Effect Size
Infiltration of incisions										
Preincisional *vs.* saline										
Pain scores	14	108.60	0.001	1.98	0.024	0.22	—	—	0.002	0.001
Nausea/vomiting	5	—	—	—	—	—	1.87	0.82–4.28	—	0.280
Time to discharge	5	17.43	0.080	1.64	0.051	0.11	—	—	0.230	0.230
Preincisional *vs.* postincisional										
Pain scores	8	49.28	0.001	0.50	0.309	0.08	—	—	0.008	0.001
Analgesic use	6	39.95	0.001	−1.26	0.104	0.10	—	—	0.001	0.001
Postincisional *vs.* saline										
Pain scores	15	120.26	0.001	4.92	0.001	0.29	—	—	0.095	0.001
Analgesic use	11	85.10	0.001	2.35	0.009	0.26	—	—	0.001	0.001
Multimodal techniques										
Two or more *vs.* single agent, 1 route										
Epidural morphine + locals *vs.* morphine										
Pain scores	8	62.50	0.001	4.19	0.001	0.51	—	—	0.015	0.001
Pruritus	5	—	—	—	—	—	0.97	0.42–2.24	—	0.045
Epidural fentanyl + locals *vs.* fentanyl										
Pain scores	11	80.06	0.001	3.23	0.001	0.30	—	—	0.015	0.002
Nausea/vomiting	11	—	—	—	—	—	1.31	0.77–2.22	—	0.250
Pruritus	12	—	—	—	—	—	1.00	0.59–1.69	—	0.210
Sedation	5	114.51	0.140	1.43	0.076	0.09	—	—	0.830	0.780
Motor block	6	—	—	—	—	—	1.18	0.48–2.88	—	0.014
Epidural sufentanil + locals *vs.* sufentanil										
Pain scores	5	47.93	0.001	3.49	0.001	0.42	—	—	0.490	0.160
Nausea/vomiting	5	—	—	—	—	—	0.83	0.35–2.01	—	0.860
Epidural morphine + bupivacaine *vs.* bupivacaine										
Pain scores	10	68.25	0.001	2.52	0.006	0.32	—	—	0.710	0.280
Nausea/vomiting	8	—	—	—	—	—	0.67	0.34–1.30	—	0.985
Pruritus	6	—	—	—	—	—	0.23	0.07–0.71	—	0.650
Epidural fentanyl + bupivacaine *vs.* bupivacaine										
Pain scores	6	40.68	0.001	1.09	0.138	0.23	—	—	0.590	0.070
Nausea/vomiting	7	—	—	—	—	—	0.78	0.35–1.74	—	0.280
Pruritus	6	—	—	—	—	—	0.19	0.08–0.49	—	0.150
Epidural fentanyl or sufentanil + ropivacaine *vs.* ropivacaine										
Pain scores	7	40.01	0.001	2.12	0.017	0.16	—	—	0.860	0.850
Nausea/vomiting	5	—	—	—	—	—	0.55	0.26–1.17	—	0.650
Pruritus	7	—	—	—	—	—	0.28	0.14–0.55	—	0.890
Motor block	5	—	—	—	—	—	0.72†	0.10–5.21	—	0.006
Epidural opioids + clonidine *vs.* opioids										
Pain scores	7	63.15	0.001	4.04	0.001	0.69	—	—	0.001	0.001
IV morphine + ketorolac *vs.* IV morphine										
Pain scores	8	66.19	0.001	5.25	0.001	0.40	—	—	0.290	0.001
Analgesic use	9	111.77	0.001	9.89	0.001	0.88	—	—	0.001	0.001
Nausea/vomiting	9	—	—	—	—	—	1.14	0.63–2.04	—	0.580
Pruritus	5	—	—	—	—	—	1.48	0.48–4.51	—	0.490
Urinary retention	5	—	—	—	—	—	1.99	0.80–4.93	—	0.051
IV morphine + ketamine *vs* IV morphine										
Pain scores	6	55.78	0.001	5.57	0.001	0.33	—	—	0.035	0.001

* Nonrandomized comparative studies are included. † DerSimonian-Laird random-effects odds ratio (OR). ‡ Effect size estimate is verified by a difference between means analysis. CI = confidence interval; IM = intramuscular; IV = intravenous.