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Review

Best evidence in multimodal pain management in spine surgery and means of assessing postoperative pain and functional outcomes

Clinton J. Devin [a,*], Matthew J. McGirt [b]

[a] Department of Orthopedic Surgery, Vanderbilt University Medical Center, 1215 21st Avenue South, Nashville, TN 37232, USA
[b] Carolina Neurosurgery and Spine Associates, Charlotte, NC, USA

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ABSTRACT

Multimodal approaches to pain management have arisen with the goal of improving postoperative pain and reducing opioid analgesic use. We performed a comprehensive literature review to determine grades of recommendation for commonly used agents in multimodal pain management and provide a best practice guideline. To evaluate common drugs used in multimodal treatment of pain, a search was performed on English language publications on Medline (PubMed; National Library of Medicine, Bethesda, MD, USA). Manuscripts were rated as Level I–V according to the North American Spine Society's (NASS) standardized levels of evidence tables. Grades of recommendation were assigned for each drug based on the NASS Clinical Guidelines for Multidisciplinary Spine Care. There is good (Grade A) evidence gabapentinoids, acetaminophen, neuraxial blockade and extended-release local anesthetics reduce postoperative pain and narcotic requirements. There is fair (Grade B) evidence that preemptive analgesia and nonsteroidal anti-inflammatory drugs (NSAID) result in reduced postoperative pain. There is insufficient and/or conflicting (Grade I) evidence that muscle relaxants and ketamine provide a significant reduction in postoperative pain or narcotic usage. There is fair (Grade B) evidence that short-term use of NSAID result in no long-term reduction in bone healing or fusion rates. Comprehensive assessment of the effectiveness of perioperative pain control can be accomplished through the use of validated measures. Multimodal pain management protocols have consistently been demonstrated to allow for improved pain control with less reliance on opioids. There is good quality evidence that supports many of the common agents utilized in multimodal therapy, however, there is a lack of evidence regarding optimal postoperative protocols or pathways.

1. Introduction

While pain is common and expected after surgery due to the inherent tissue damage that occurs during surgical procedures, there is growing evidence that this pain may be inadequately managed in many patients [1]. More recently, the management of pain has become a greater focus of healthcare organizations, individual clinicians and even the USA government. In 1995, the American Pain Society, in conjunction with the American Society of Anesthesiologists, began a national campaign to address the perceived under-treatment of pain [2]. The 'Pain as the Fifth Vital Sign' initiative emerged in 1998 from the Veterans Affairs system, followed in 2001 by implementation of new pain management standards by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) [3]. Comprehensive pain assessment should be able to evaluate four elements of pain: 1) intensity, 2) quality, 3) effect on function and quality of life, 4) objective assessment of amount of pain medication being used. Despite these efforts, the incidence and severity of postoperative pain has remained high [1,4].

With the implementation of the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) Survey there is more scrutiny than ever on perioperative pain management as this publicly reported survey includes several questions that directly assess the quality of pain management in the perioperative period as one of several key performance metrics [5]. Many spinal procedures are often associated with intense pain in the immediate and early postoperative period making its control of primary importance. Poorly controlled pain often causes a reduction in patient mobility which may ultimately lead to an increase in complications such as deep vein thrombosis, pulmonary embolus and pneumonia. Additionally, effective pain control in the perioperative

* Corresponding author. Tel.: +1 615 875 5100; fax: +1 615 875 6158.
E-mail address: Clinton.j.devin@vanderbilt.edu (C.J. Devin).

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period has been shown to be associated with improved surgical outcome [6,7], reduced hospital stays [6–8] and decreased development of new chronic pain conditions [9,10].

Opioid analgesics are a first-line agent in the management of postoperative pain, however, overuse can be associated with significant adverse side effects including somnolence, confusion, urinary retention, ileus, respiratory depression and death. Postoperative pain is mediated through a variety of neurophysiological and chemical pathways. Additionally, peripheral and central sensitization further contributes to the development of hyperalgesia with the result of increased pain. Therefore, multimodal approaches to pain management have arisen with the goal of targeting a number of these pain signaling pathways to improve patient pain while minimizing side effects [11]. Multimodal pain management has the potential to decrease postoperative pain while reducing the total opioid consumption [12].

We set out to perform a comprehensive literature review to determine grades of recommendation for various commonly used agents in multimodal pain management and provide a best practices guideline. We also provide a means of comprehensively assessing pain in the postoperative period.

2. Methods

To evaluate common drugs used in multimodal treatment of pain, search terms were identified and combined with appropriate Boolean connectors and a search was carried out on English language publications in Medline (PubMed; National Library of Medicine, Bethesda, MD, USA). All abstracts obtained from these search criteria were reviewed. Case reports, technical notes and animal or laboratory studies were discarded. The remaining manuscripts were then read in their entirety and rated as Level I–V according to the North American Spine Society's (NASS) adopted, standardized, levels of evidence tables [13].

Two reviewers independently assigned levels of evidence to each study. Any discrepancies in the assigned level of evidence were discussed between reviewers at the conclusion of evidence rating. If needed, a blind assessment was made by a third reviewer to finalize the level of evidence. The best research evidence available was used to evaluate each drug assessed. That is, if Level I, II or III studies were available to answer a specific question, Level IV or V studies were not reviewed.

2.1. Grades of recommendation

Grades of recommendation were assigned for each drug based on the NASS Clinical Guidelines for Multidisciplinary Spine Care (Table 1) [14]. Good (Grade A) evidence is comprised of Level I studies with consistent findings. Fair (Grade B) evidence consists of Level II or III studies with consistent findings. Poor quality (Grade C) evidence is composed of Level IV or V studies with consistent findings. Finally, insufficient (Grade I) evidence is defined as inconsistent findings or lack of investigation.

Table 1
North American Spine Society (NASS) grades of recommendation for summaries of reviews or studies*

Grade	Description
A	Good evidence (Level I studies with consistent findings)
B	Fair evidence (Level II or III studies with consistent findings)
C	Poor quality evidence (Level IV or V studies)
I	Insufficient or conflicting evidence that precludes making a recommendation

* Levels of evidence adopted from NASS level of evidence tables [13].

3. Results

A multimodal approach is preferred for perioperative pain management in spine surgery. Evidence suggests that chronic opioid use in the preoperative period may have a negative impact on outcomes following spinal procedures. Chapman et al. compared patients with and without a history of chronic opioid use that were undergoing orthopedic surgery and discovered that patients who reported chronic use experienced greater severity of acute pain and slower pain resolution despite adjusting for additional opioid administration [15]. Zywiel et al. also demonstrated a higher risk of complications and prolonged painful recoveries in chronic opioid users undergoing total knee arthroplasty [16]. Additional work has similarly found worse outcomes in chronic opioid users undergoing anterior cervical discectomy and fusion [17]. This body of evidence underscores the importance of incorporating opioid use assessment as a routine part of the preoperative evaluation. Table 2 provides conversion ratios for common opioids that can be used to calculate the daily morphine equivalent amounts that a patient is consuming preoperatively. An algorithmic approach to managing varying degrees of preoperative opioid use in the spine surgery patient is provided in Figure 1.

The following represents a review of the literature for evidence on the effectiveness of commonly used agents in multimodal pain management and grades of recommendation based on available evidence. A summary of the grades of recommendation for each drug or class of drugs is provided in Table 3 and an evidence table for each agent discussed is provided in Table 4.

Finally, we describe means of comprehensively assessing pain in the postoperative period from the acute care episode in the hospital to extended time points in the postacute care episode.

4. Peri-operative pain management

4.1. Preemptive analgesia

Preemptive analgesia is the administration of pain medication in the preoperative period with the objective of exerting a preventive effect against postoperative pain through the inhibition of central autonomic hyperactivity. Proper preemptive analgesia

Table 2
Morphine equivalent conversion ratios for common opioid drugs

Opioid	Ratio (mg morphine/mg opioid)
Fentanyl patch	30/12.5
Hydrocodone (oral)	30/30
Hydromorphone (oral)	30/7.5
Meperidine (oral)	30/300
Methadone (oral)	30/20
Morphine (oral)	30/30
Nalbuphine (oral)	30/10
Oxycodone (oral)	30/20
Oxymorphone (oral)	30/10
Propoxyphene (oral)	10/130
Tapentadol (oral)	30/100
Tramadol (oral)	1/10
Fentanyl (IV)	75/1
Hydrocodone (IV)	30/20
Hydromorphone (IV)	30/1.5
Meperidine (IV)	30/300
Methadone (IV)	30/20
Morphine (IV)	30/10
Nalbuphine (IV)	30/10
Oxycodone (IV)	30/20
Remifentanyl (IV)	250/1
Sufentanyl (IV)	30/0.015

IV = intravenous.